NATIONAL PETROLEUM RESERVE IN ALASKA

HISTORY
OF
DRILLING OPERATIONS

SOUTH BARROW WELL NO. 19

HUSKY OIL NPR OPERATIONS, INC.
Edited by: S. L. Hewitt and Ronald G. Brockway

For the

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

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SOUTH BARROW WELL NO. 19

INTRODUCTION

South Barrow Well No. 19, 9.7 miles southeast of Barrow, Alaska, was drilled to delineate the northern limits of the East Barrow Gas Field (Figure 1). The designation "East Barrow Gas Field" is now applied to those wells which were earlier identified as "South Barrow Gas Field, East Area" because the South Barrow Gas Field and the East Barrow Gas Field area are now recognized as being two separate fields. The well is situated 1,320 feet from the east line and 1,320 feet from the south line in the southeast quarter of protracted Section 23, Township 22 North, Range 17 West, Umiat Meridian (Latitude: 71°14'29.470" North: Longitude: 156°20'01.687" West; Alaska State Plane Coordinates are X = 596,243.93, and Y = 6,306,608.67, Zone 6).

Drilling related operations started on January 27, 1978, with the mobilization of construction crews and equipment for the building of the drilling location. Rig-up operations began on April 14, 1978. Operations at South Barrow No. 19 ended on May 11, 1978, with the final movement of rig components and a general location cleanup. Elevations are Ground Pad 12 and Kelly Bushing 30'.

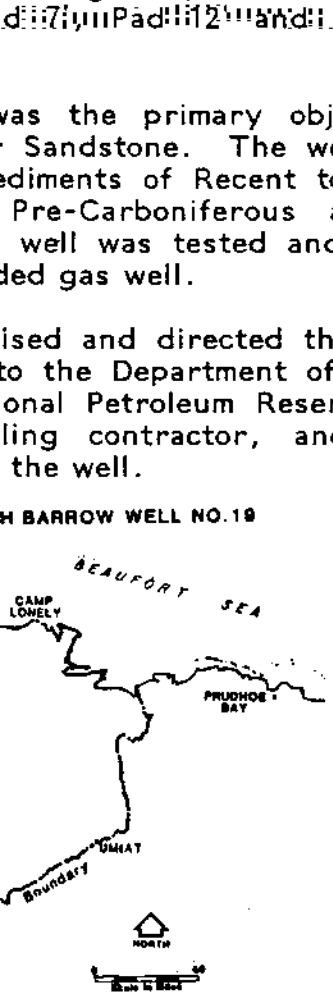
was the primary objective with a Sandstone. The well was drilled ediments of Recent to Triassic age Pre-Carboniferous age. At the well was tested and completed in ded gas well.

The lower Jurassic Barrow gas sand secondary objective being the Sag River to a total depth of 2300', penetrating s and terminating in the argillite of conclusion of the drilling operations, the the Barrow gas sand and left as a suspen

ised and directed the drilling and to the Department of the Interior, onal Petroleum Reserve in Alaska. ling contractor, and Brinkerhoff the well.

Husky Oil NPR Operations, Inc. superv support operations as prime contractor U. S. Geological Survey, Office of Nat Brinkerhoff Signal, Inc. was the dri Rig 31, a National T-20, was used to drill

H BARROW WELL NO. 19



- SOUTH BARROW NO. 19

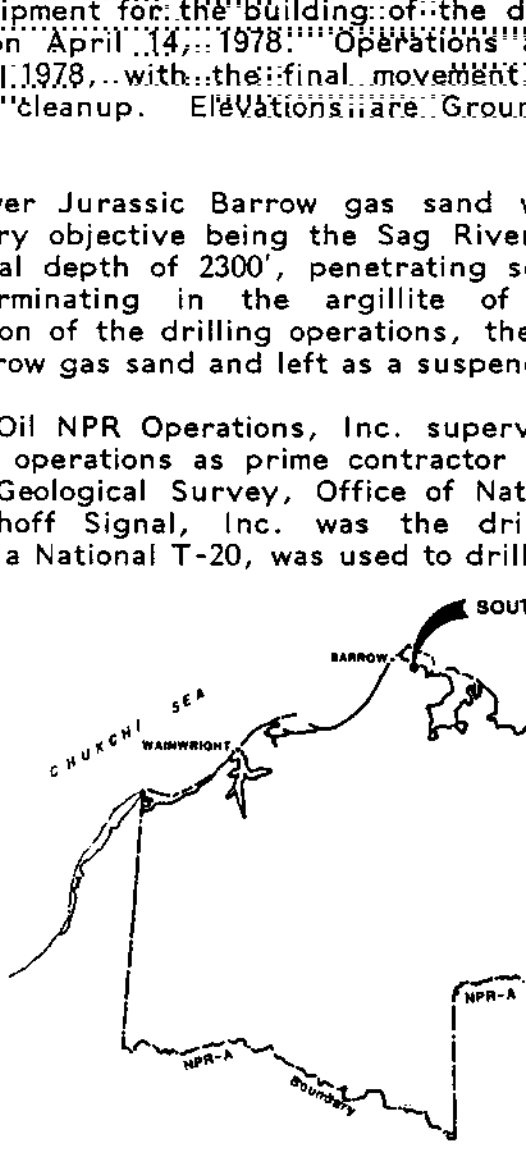


FIGURE 1 - WELL LOCATION MAP

DRILLING SUMMARY

Field operations at the South Barrow Well No. 19 location began on January 27, 1978, with construction of the drilling pad and camp location. The rig and camp were moved from the South Barrow No. 17 location, starting on April 14, 1978. The rig components and camp were moved simultaneously, and rig-up began as they arrived on location. The 13-3/8" conductor was run to 80' (drillers depth) and cemented with 210 sacks of Permafrost cement on April 16. A 12-inch annular blowout preventer and diverter line were installed on the 13-3/8" conductor and pressure tested. Rig-up was completed, and the well was spudded April 18, 1978, at 5:00 a.m.

A 12-1/4" hole was drilled from 80' to 1330'. The hole was then cored from 1330' to 1360', recovering thirty feet of core. The hole was reamed to 12-1/4" from 1330' to 1358' and drilled to 1500'. The hole was conditioned and logged from 1498' to the bottom of the 13-3/8" conductor with DIL/SP and BHC-Sonic/GR. Thirty sidewall cores were shot in the interval from 1348' to 1476' with 29 being recovered.

The 9-5/8", 53.5#, S-95 casing was run to 1491.87' and cemented in with 1,020 sacks of Permafrost cement on April 23, 1978. A 12", 3,000 psi blowout-preventer stack was installed on the 9-5/8" casing. The blowout-preventer rams, choke manifold, and kill lines were tested to 3,000 psi. The Hydril was tested to 1,500 psi. The Barrow sandstones were known to have swelling clays (tests from South Barrow wells Nos. 12 and 13), and in order to minimize formation damage, an inhibitive mud system containing calcium chloride was mixed and the system changed over. The casing was drilled out with an 8-1/2" bit and the formation tested to a 0.61 psi/ft. equivalent gradient.

An 8-1/2" hole was drilled to 2175'. At 2039', while conditioning the hole, high gas values were noted on the mud log, and gas-cut mud was observed at the surface. Mud weight was increased to 11.6 ppg. A slow mud loss began. Lost-circulation material was added and volume built. The hole was stabilized at a mud weight of 11.9 ppg after having lost 75 barrels of mud. Core No. 2 was cut from 2039' to 2069' with full recovery. The mud weight was cut to 11.4 ppg. While tripping with the core barrel, the hole began swabbing and flowing through the drill pipe. After installing an inside blowout preventer and running back to bottom, the mud weight was increased to 11.6 ppg to control the hole.

At 2175', the hole was conditioned and logged as follows: DLL/MSFL/GR; FDC/CNL/CAL/GR; BHC-Sonic/GR; HDT-Dipmeter; and Velocity Survey. Forty-five sidewell cores were shot in the interval 1585' to 2153' with a recovery of 37.

Fifty-five joints of 38#, S-95, seven-inch production casing was run to 2161' and cemented with 103 sacks of Class "G" cement with two percent calcium chloride. After changing out the blowout-preventer stack to the 7" casing and pressure testing the stack and circulating system, the FO cementing collar at 1288' was opened and the 7" cement job was tested to

2,000 psi. The annulus was then washed with 87 barrels of water. This was followed by 45 barrels of 113 ppg Arctic Pack pumped through the FO at 1204'. With FO closed the operation was again pressure tested to 2000#. The shoe and 10' of additional hole was drilled (2175-2185'), and the formation tested to an equivalent gradient of 0.61 psi/ft. The hole was drilled to 2209', then circulated in preparation for coring.

A 5-5/8" hole was drilled to a total depth of 2300'. Cores were cut as follows: Core No. 3, 2209' to 2217', recovered 4', Core No. 4, 2217' to 2230', recovered 9'; Core No. 5, 2230' to 2245', recovered 15'. Open hole Drill-Stem Test No. 1 was conducted on the interval from 2161' (7" shoe) to 2245' (Sag River Sandstone). The packer was set in the 7" casing at 2129' and a 540 psi nitrogen cushion used. The test is summarized as taken from wellsite geologist's DST report:

> Initial Flow Period: Tool opened and nitrogen bled off in 4 minutes; drilling mud to surface in 11 minutes; gas to surface in 23 minutes; flowing surface pressure on 1/2" choke stabilized at 64 psi in 156 minutes, on 3/4" choke at 40 psi in 223 minutes, well shut in at 225 minutes; shut in for 367 minutes; bottom-hole pressures at 2216' IHP 1,270 psi, flow pressure from 331 to 204 (increasing choke sizes); shut-in pressure 1,017 psi, FHP 1,220 psi.
>
> Recovery: Estimated 800,000 CFGPD and 7.125 gallons, gassy and very slightly oil-cut emulsified mud.

The well was logged at 2300' as follows: FDC/CNL/CAL/GR; BHC-Sonic/GR; DLL/SP/GR, MLL.

After evaluation of logs, a decision was made to plug back and complete the well in the interval 2018' to 2044'. A plug was set from 2300' to 2100' with 53 sacks of Class "G" cement (2% calcium chloride). A cement-bond log was run and indicated adequate cement behind the 7" casing for isolation of the test zone. A drillable bridge plug was set at 2085'.

In continued preparation for completion of the Barrow gas sand, the drilling mud was displaced with 11.5 ppg jelled calcium-chloride water, drill pipe and collars were laid down, and the 2-7/8" tubing was picked up and stood back. The blowout-preventer stack was changed out to 2-7/8" and tested to 3,000 psi. The perforating lubricator was rigged and tested, and the casing was perforated from 2018' to 2044' with Schlumberger's 4" Hyperjet II tool at four shots per foot.

The 2-7/8" tubing was run and hung at 2049' with a back-pressure valve in place, and the blowout preventer was removed and replaced with a test tree. The well was then displaced with nitrogen through the 2-7/8" annulus, vented to the atmosphere, and allowed to flow through the tubing. After rocking several times for cleanup, pressure tools were run to bottom and a six-hour initial flow was conducted to establish reasonable four-point rates. A four-point flow test (Production Test No. 1) and a 51-hour shut-in were performed with bottom-hole pressure recorders in

place. Indicated AOF was 7.22 MMCF/D with an initial reservoir pressure of 984.0 psi. No liquids were produced during the test (see Appendix No. III for a detailed analysis of test).

Pressure recorders were pulled, and the well was killed with 11.0 ppg calcium-chloride water. The test tree was removed and replaced with the blowout-preventer stack prior to pulling the 2-7/8" tubing. A Baker Model K retainer was set at 1968'. Tubing was pulled up to 500' and the 11.0 ppg calcium-chloride water was displaced by that weighing 10.8 ppg. The tubing was then rehung at 1929'. The tubing back-pressure valve was run, and the blowout-preventer stack was replaced with the wellhead tree. The tree was tested to 3,000 psi and left filled with a 50 percent alcohol-water solution.

The rig was released May 16, 1978, at 12:00 midnight.

All logs from the South Barrow No. 19 well were recorded on magnetic tape for ease in computer interpretation. The hole was nearly straight, with a maximum deviation of 1-1/2° at depths of 1331' and 1790'.

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

Form 9-331 C
(May 1963)

SUBMIT IN DUPLICATE*
(Other instructions on reverse side)

Form approved.
Budget Bureau No. 42-R1425.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

NOTICE OF INTENT TO DRILL, DEEPEN, OR PLUG BACK

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

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

2. NAME OF OPERATOR: National Petroleum Reserve in Alaska (through Husky Oil NPR Operations, Inc.)

3. ADDRESS OF OPERATOR: 2525 C Street, Suite 400, Anchorage, AK 99503

4. LOCATION OF WELL (Report location clearly and in accordance with any State requirements.*)
At surface: 1320' FEL and 1320' FSL
At proposed prod. zone: Same (straight hole)

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

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

7. UNIT AGREEMENT NAME: N/A

8. FARM OR LEASE NAME: National Petroleum Reserve in AK

9. WELL NO.: So. Barrow Well No. 19 (East Area)

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

11. SEC., T., R., M., OR BLK. AND SURVEY OR AREA: Sec 23, T22N, R17W, UM

12. COUNTY OR PARISH: North Slope Borough, AK

13. STATE: AK

14. DISTANCE IN MILES AND DIRECTION FROM NEAREST TOWN OR POST OFFICE*: 9.7 miles southeast of Barrow, Alaska

15. DISTANCE FROM PROPOSED* LOCATION TO NEAREST PROPERTY OR LEASE LINE, FT. (Also to nearest drlg. unit line, if any): 7000'

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

17. NO. OF ACRES ASSIGNED TO THIS WELL: N/A

18. DISTANCE FROM PROPOSED LOCATION* TO NEAREST WELL, DRILLING, COMPLETED, OR APPLIED FOR, ON THIS LEASE, FT.: 1500'

19. PROPOSED DEPTH: 2,425'

20. ROTARY OR CABLE TOOLS: Rotary

21. ELEVATIONS (Show whether DF, RT, GR, etc.): Ground = 7'; Pad = 12'; KB = 30'

22. APPROX. DATE WORK WILL START*: March 10, 1978

23. PROPOSED CASING AND CEMENTING PROGRAM

SIZE OF HOLE	SIZE OF CASING	WEIGHT PER FOOT	SETTING DEPTH	QUANTITY OF CEMENT
17 1/2"	13 3/8"(Cond.)	72# (S-95)	110' KB	± 100 Sx Permafrost to Surface
12 1/4"	9 5/8"	53.5# (S-95)	1500'	± 1020 Sx Permafrost to Surface
8 1/2"	7"	38# (S-95)	2255'	± 100 Sx Class "G" w/additives from TD to ± 1600'. Second stage: Down Squeeze through FO @ ± 1300' w/± 60 sx Permafrost. Arctic Pack 9 5/8" X 7" annulus through FO @ 1220' w/± 60 bbls Arctic Pack.

Blowout Preventer Program:

From ± 110' KB to ± 1500'
12", 3000 psi, SA Diverter Assembly

From ± 1500' to TD:
12", 3000 psi, SRRA BOP Assembly
w/3000 psi Choke Manifold and Kill Line

See Drilling Program for details.

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ANCHORAGE, ALASKA

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 [signature] TITLE Chief of Operations DATE December 15, 1977

(This space for Federal or State office use)

CONFORMS WITH PERTINENT PROVISIONS 30 CFR 221

BY [signature] TITLE Oil and Gas Supervisor DATE 5/21/78

CONDITIONS OF CONCURRENCE ATTACHED

*See Instructions On Reverse Side

AREA

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 National Petroleum Reserve in Alaska (through Husky Oil NPR Operations, Inc.)

3. ADDRESS OF OPERATOR
2525 C Street, Suite 400, Anchorage, AK 99503

4. LOCATION OF WELL (REPORT LOCATION CLEARLY. See space 17 below.)
AT SURFACE: 1320' FEL, 1320' FSL
AT TOP PROD. INTERVAL:
AT TOTAL DEPTH:

5. LEAS
N/A

6. IF INDIAN, ALLOTTEE
N/A

7. UNIT AGREEMENT NA
N/A

8. FARM OR LEASE NAME
Petroleum Reserve

9. WELL NO.
South Barrow Well

10. FIELD OR WILDCAT NA
South Barrow Gas F

11. SEC., T., R., M., OR BL AREA
Sec 23, T22N, R17W

12. COUNTY OR PARISH
North Slope

14. API NO.

15. ELEVATIONS (SHOW
30' KB

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

NOTICE OF INTENT 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) Subsequent Report of Spud			

(NOTE: Report results of mul... change on Form 9-3...

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

This well was spudded on April 18, 1978, at 5:00 AM. Drilling commence... hole.

Subsurface Safety Valve: Manu. and Type _____ Set @

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

SIGNED Max C Brewer TITLE Chief of Operations DATE April 25

(This space for Federal or State office use)

Conforms with pertinent provisions of 30 CFR 221.

APPROVED BY _____ TITLE DISTRICT SUPERVISOR DATE 5/1/...

AREA

*See Instructions on Reverse Side

Amended March 28, 1983

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 National Petroleum Reserve in Alaska (through Husky Oil NPR Operations, Inc.)

3. ADDRESS OF OPERATOR
2525 C Street, Suite 400, Anchorage, AK 99503

4. LOCATION OF WELL (REPORT LOCATION CLEARLY. See space 17 below.)
AT SURFACE: 1320' FEL, 1320'FSL
AT TOP PROD. INTERVAL:
AT TOTAL DEPTH:

5. LEASE
N/A

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

7. UNIT AGREEMENT NAME
N/A

8. FARM OR LEASE NAME National Petroleum Reserve in Alaska

9. WELL NO.
South Barrow Well No. 19

10. FIELD OR WILDCAT NAME
South Barrow Gas Field

11. SEC., T., R., M., OR BLK. AND SURVEY OR AREA
Sec 23, T22N, R17W, UM

12. COUNTY OR PARISH | 13. STATE

14. API NO.
30'KB

15. ELEVATIONS (SHOW DF, KDB, AND WD)

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

NOTICE OF INTENT TO:		SUBSEQUENT REPORT OF:	
TEST WATER SHUT-OFF	☐		☐
FRACTURE TREAT	☐		☐
SHOOT OR ACIDIZE	☐		☐
REPAIR WELL	☐		☐
PULL OR ALTER CASING	☐		☐
MULTIPLE COMPLETE	☐		☐
CHANGE ZONES	☐		☐
ABANDON*	☐		☐

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

(other) Subsequent Report of Running and Cementing 9 5/8" Surface Casing.

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.)*

Drilled 12 1/4" hole to 1500' and logged (DIL/SP BHC/GR/TTI/Caliper), shot 30 sidewall core, recovered 29 (1348-1476'). Ran 38 joints of 9 5/8", 53.5 #/ft, S-95 Buttress casing with the float shoe at 1491' and the duplex float collar at 1444'. Centralizers were run as per the original well plan. Cemented with 1020 sacks of Permafrost cement at 14.8 ppg slurry weight. Full returns throughout cement job. CIP at 2:00 PM, 4/23/78. WOC 16 hours. Cut off 13 3/8" braden head. Cut off 9 5/8" casing and weld on 10", 3000 psi starter head. Nipple up 12", 3000 psi SRRA BOP stack. Test rams, manifold, and kelly cocks to 3000 psi and Hydril to 1500 psi. Tested 9 5/8" casing to 1600 psi. Drilled out float collar and shoe and 10 feet of formation. Tested formation to 0.61 psi/ft equivalent gradient with no observed leakoff. Resumed drilling.

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

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

SIGNED _____ TITLE Chief of Operations DATE _____

(This space for Federal or State office use)

Conforms with pertinent provisions of 30 CFR 221.

_____ TITLE _____ DATE _____

*See Instructions on Reverse Side

Amended March 28, 1983

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 National Petroleum Reserve in Alaska (through Husky Oil NPR Operations, Inc.)

3. ADDRESS OF OPERATOR
2525 C Street, Suite 400, Anchorage, AK 99503

4. LOCATION OF WELL (REPORT LOCATION CLEARLY. See space 17 below.)
AT SURFACE: 1320' FEL, 1320' FSL
AT TOP PROD. INTERVAL:
AT TOTAL DEPTH:

5. LEASE
N/A

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

7. UNIT AGREEMENT NAME
N/A

8. FARM OR LEASE NAME National Petroleum Reserve in Alaska

9. WELL NO.
South Barrow Well No. 19

10. FIELD OR WILDCAT NAME
South Barrow Gas Field

11. SEC., T., R., M., OR BLK. AND SURVEY OR AREA
Sec 23, T22N, R17W, UM

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

14. API NO.

15. ELEVATIONS (SHOW DF, KDB, AND WD)
30' KB

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

NOTICE OF INTENT 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) Subsequent Report of Running and Cementing 7" Casing			

(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.)*

An 8 1/2" hole was drilled to 2175'. The hole was conditioned, logs run, (DLL/SP, FDC/CNL/GR/Caliper, BHC/GR/TTI/Caliper, CBL/VDL/GR), shot 45 sidewall cores, recovered 37 w/1585-2153'), 55 joints of 7", 38 #/ft, J-55, Buttress casing was vacuum, and landed at 2161'. The float collar was located at 2122'. The FO cementing sleeves were positioned at 1288' and 1204'. Centralizers were run as per the original well plan. Pumped 15 barrels of water containing 2% Cla-Sta. Mixed and pumped 103 sacks of Class G cement with 2% calcium chloride through drill pipe using duplex cementing technique. Cement in place at 1:18 AM on 5/2/78. Full returns throughout cement job. Opened lower FO and circulated. Closed lower FO and cycled upper FO as tools were pulled out of hole. Landed casing and installed tubing head and tested flange to 3000 psi. Nipple up 12", 3000 psi SRRA BOP system and tested rams, chokes and kelly cocks to 3000 psi and Hydril to 1500 psi. Reopened lower FO at 1288' and tested formation and cement to 650 psi with no leak off. Closed FO and pulled up to upper FO at 1204'. Pumped 67 barrel water wash followed by 45 barrels of 11.3 ppg Arctic Pack. Good job throughout with retort on final pack

(Continued on attached page)

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

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

SIGNED _____ TITLE Chief of Operations DATE _____

(This space for Federal or State office use)

Conforms with Pertinent provisions of 30 CFR 221.

APPROVED BY _____ TITLE _____ DATE _____

*See Instructions on Reverse Side

Amended March 28, 1983

Sundry Notices and Reports on Wells
Subsequent Report of Running and Cementing 7" Casing
South Barrow Well No. 19

returns indicating only 1% excess water. Arctic Pack in place at 3:20 PM on 5/3/78. Closed FO and pressure tested to 2000 psi o.k. Drilled cement and float collar. Tested casing to 2000 psi. Drilled out to 2185' and tested formation to 0.61 psi/ft equivalent gradient.

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.

RECEIVED
JUN 28 1978
CONSERVATION DIVISION
U.S. GEOLOGICAL SURVEY
ANCHORAGE, ALASKA
ONSHORE DIST. OFFICE

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 Suspended

2. NAME OF OPERATOR: National Petroleum Reserve in Alaska (through Husky Oil NPR Operations, Inc.)

3. ADDRESS OF OPERATOR: 2525 C Street, Suite 400, Anchorage, AK 99503

4. LOCATION OF WELL (Report location clearly and in accordance with any State requirements)*
At surface: 1320' FEL, 1320' FSL
At top prod. interval reported below: (Straight hole)
At total depth: (Straight hole)

5. LEASE DESIGNATION AND SERIAL NO.: N/A
6. IF INDIAN, ALLOTTEE OR TRIBE NAME: N/A
7. UNIT AGREEMENT NAME: N/A
8. FARM OR LEASE NAME: National Petroleum Reserve in AK
9. WELL NO.: South Barrow Well No. 19
10. FIELD AND POOL, OR WILDCAT: South Barrow Gas Field
11. SEC., T., R., M., OR BLOCK AND SURVEY OR AREA: Sec 23, T22N, R17W, UM
12. COUNTY OR PARISH: North Slope
13. STATE: Alaska

14. PERMIT NO.: N/A
DATE ISSUED: N/A

15. DATE SPUDDED	16. DATE T.D. REACHED	17. DATE COMPL. (Ready to prod.?)	18. ELEVATIONS (DF, RKB, RT, GR, ETC.)	19. ELEV. CASINGHEAD
4/18/78	5/6/78	5/16/78 Suspended	30' KB	12'

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
2300' MD & TVD	2085' MD & TVD	N/A	⟶	Rotary	

24. PRODUCING INTERVAL(S), OF THIS COMPLETION—TOP, BOTTOM, NAME (MD AND TVD)*
2018 - 2044' MD & TVD - Barrow Sand

25. WAS DIRECTIONAL SURVEY MADE: No

26. TYPE ELECTRIC AND OTHER LOGS RUN
DIL-SP, BHC Sonic-GR, FDC, FDC/FDC-CNL, MLL-ML, HRD, Velocity

27. WAS WELL CORED: Yes

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

CASING SIZE	WEIGHT, LB./FT.	DEPTH SET (MD)	HOLE SIZE	CEMENTING RECORD	AMOUNT PULLED
13 3/8"	72# (S-95)	80' MD	17 1/2"	210 Sx Permafrost	None
9 5/8"	53.5# (S-95)	1492' MD	12 1/4"	1020 Sx Permafrost	None
7"	38# (S-95)	2161' MD	8 1/2"	103 Sx Class "G" + 2% CaCl2	None

29. LINER RECORD

SIZE	TOP (MD)	BOTTOM (MD)	SACKS CEMENT*	SCREEN (MD)
None				

30. TUBING RECORD

SIZE	DEPTH SET (MD)	PACKER SET (MD)
2 7/8"	1929'	None

31. PERFORATION RECORD (Interval, size and number)
2018 - 2044' Md
4 Inch Hyperjet II
4 Shots per Foot

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

DEPTH INTERVAL (MD)	AMOUNT AND KIND OF MATERIAL USED
2300 - 2100' MD	53 Sx Class G + 2% CaCl2
	Open Hole Plug Back

33.* PRODUCTION

DATE FIRST PRODUCTION	PRODUCTION METHOD (Flowing, gas lift, pumping—size and type of pump)	WELL STATUS (Producing or shut-in)
5/11/78	Flowing	Shut in

DATE OF TEST	HOURS TESTED	CHOKE SIZE	PROD'N. FOR TEST PERIOD	OIL—BBL.	GAS—MCF.	WATER—BBL.	GAS-OIL RATIO
5/12/78	18.5	29/64	⟶	-	1716	-	-

FLOW. TUBING PRESS.	CASING PRESSURE	CALCULATED 24-HOUR RATE	OIL—BBL.	GAS—MCF.	WATER—BBL.	OIL GRAVITY-API (CORR.)
724.45 psia	846.65 psia	AOF ⟶		7220		

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

TEST WITNESSED BY

35. LIST OF ATTACHMENTS: Four Point Test Data

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

SIGNED Max S Brewer TITLE Chief of Operations DATE 28 June 78

Amended March 28, 1983

INSTRUCTIONS

General: This form is designed for submitting a complete and correct well completion report and log on all types of lands and leases to either a Federal agency or a State agency, or both, pursuant to applicable Federal and/or State laws and regulations. Any necessary special instructions concerning the use of this form and the number of copies to be submitted, particularly with regard to local, area, or regional procedures and practices, either are shown below or will be issued by, or may be obtained from, the local Federal and/or State office. See instructions on items 22 and 24, and 33, below regarding separate reports for separate completions.
If not filed prior to the time this summary record is submitted, copies of all currently available logs (drillers, geologists, sample and core analysis, all types electric, etc.), formation and pressure tests, and directional surveys, should be attached hereto, to the extent required by applicable Federal and/or State laws and regulations. All attachments should be listed on this form, see item 35.
Item 4: If there are no applicable State requirements, locations on Federal or Indian land should be described in accordance with Federal requirements. Consult local State or Federal office for specific instructions.
Item 18: Indicate which elevation is used as reference (where not otherwise shown) for depth measurements given in other spaces on this form and in any attachments.
Items 22 and 24: If this well is completed for separate production from more than one interval zone (multiple completion), so state in item 22, and in item 24 show the producing interval, or intervals, top(s), bottom(s) and name(s) (if any) for only the interval reported in item 33. Submit a separate report (page) on this form, adequately identified, for each additional interval to be separately produced, showing the additional data pertinent to such interval.
Item 29: "*Sacks Cement*": Attached supplemental records for this well should show the details of any multiple stage cementing and the location of the cementing tool.
Item 33: Submit a separate completion report on this form for each interval to be separately produced. (See instruction for items 22 and 24 above.)

37. SUMMARY OF POROUS ZONES: SHOW ALL IMPORTANT ZONES OF POROSITY AND CONTENTS THEREOF; CORED INTERVALS; AND ALL DRILL-STEM TESTS, INCLUDING DEPTH INTERVAL TESTED, CUSHION USED, TIME TOOL OPEN, FLOWING AND SHUT-IN PRESSURES, AND RECOVERIES				38. GEOLOGIC MARKERS		
FORMATION	TOP	BOTTOM	DESCRIPTION, CONTENTS, ETC.	NAME	TOP MEAS. DEPTH	TOP TRUE VERT. DEPTH
Lower Barrow sand	2020'	2040'	Sandstone: light gray, tan, very fine grained, friable, clean, occasional dark green glauconite grains, clayey matrix in part; slight sample stain, gold sample flourescence, yellow cut flourescence. Core No. 2: 2039 - 2069'; cut and recovered 30 feet. Sandstone as above becoming very argillaceous grading to Siltstone with scattered spotty sample flourescence. Production Test No. 1: 2018' - 2044'. Four perforations per foot through 7" casing. 1.17 MMCF/D on 1/4" choke at 924 psi FWHP; 7.22 MMCF/D CAOF. (See page 13.)	"Pebble Shale" L. Barrow sand Sag River Sandstone Argillite (Basement)	1352' 2018' 2194' 2264'	
Sag River Sandstone	2198'	2265'	Sandstone: brown, very fine-fine grained quartz with common to abundant glauconite; occasional to common shell and echonoid fragments in lower part; sub- to well rounded, well sorted; grades to interbedded sandy, biocalcarenite, Limestone.			

U.S. GOVERNMENT PRINTING OFFICE: 1983—O-403436

671-233

Amended March 28, 1983

nce, bleeding oil and

tool open 225 minutes, on 3/4" choke, re- ulsified drilling fluid ; ISIP 1017, FFP

Formation	Top	Bottom	Description, Contents, Etc.
Sag River Sand-stone (cont.)			with depth; good brown oil stain, gold sample fluorescence gas in part on cores. Average Ø 15%, average Sw 48%. Core No. 3: 2209 - 2217'; cut 8 feet, recovered 4 feet Core No. 4: 2217 - 2230'; cut 13 feet, recovered 9 fee Core No. 5: 2230 - 2245'; cut and recovered 15 feet. DST No. 1: 2161 - 2245'. 540 psi nitrogen gas cushion gas to surface in 23 minutes, stabilized at 39 psi FWHP covered 7 gallons of gassy and very slightly oil cut m below DCIP valve. Bottom hole pressures: IFP, 331 psi 204 psi; FHH 1220.

Amended March 28, 1983

PRODUCTION TEST NO. I
EXAMPLE CALCULATION II

Four Point Flow Test - 5/12/78

Initial Reservoir Pressure = 984 psia

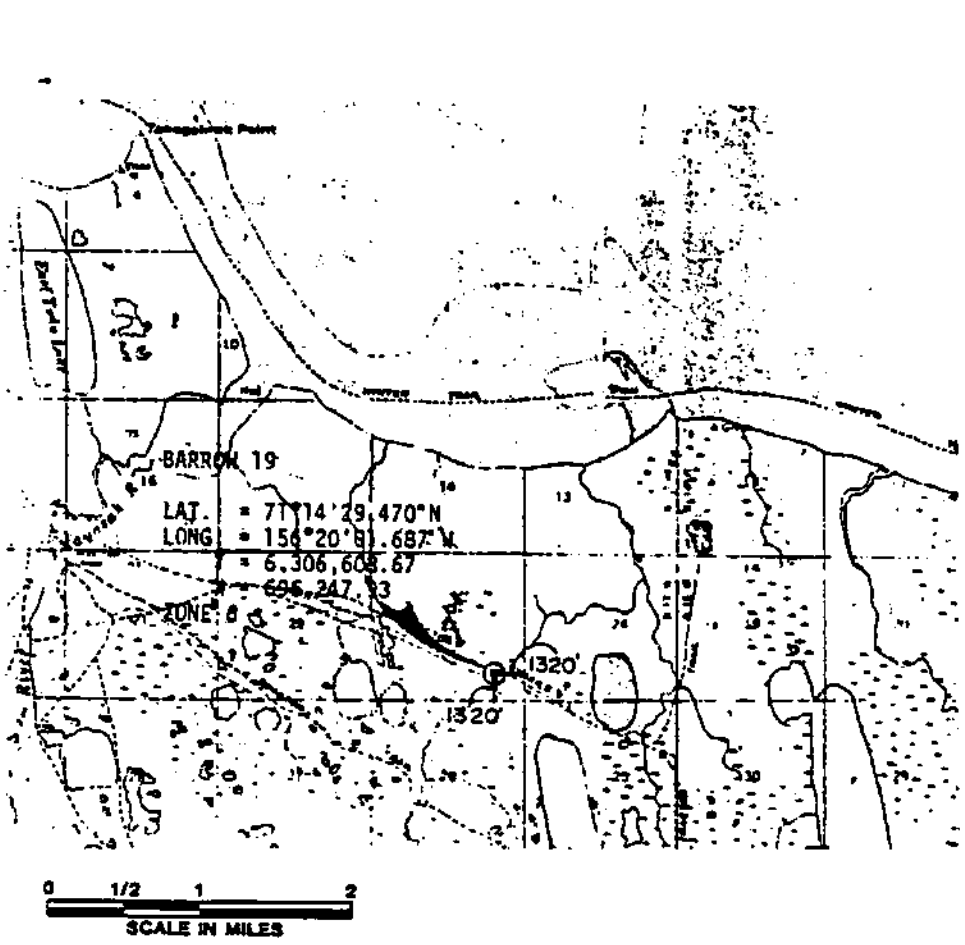
Rate	Choke	Pressure	Flow Rate	ΔP^2
1	16/64	924.2 psia	1.170 M^2cF/d	114077
2	22/64	858.5 psia	2.188 M^2cF/d	231233
3	26/64	779.4 psia	3.191 M^2cF/d	360826
4	29/64	724.5 psia	3.687 M^2cF/d	445165

AOF = 7.220 M^2cF/d

n = .844

c = .000064062 $\frac{M^2cF/d}{ps^2}$

ATTACHMENT 1



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.

August 24, 1977

STATE OF ALASKA 49TH
JOHN H. HERRING
No. 953-S
REGISTERED PROFESSIONAL LAND SURVEYOR

AS STAKED

BARROW 19

LOCATED IN

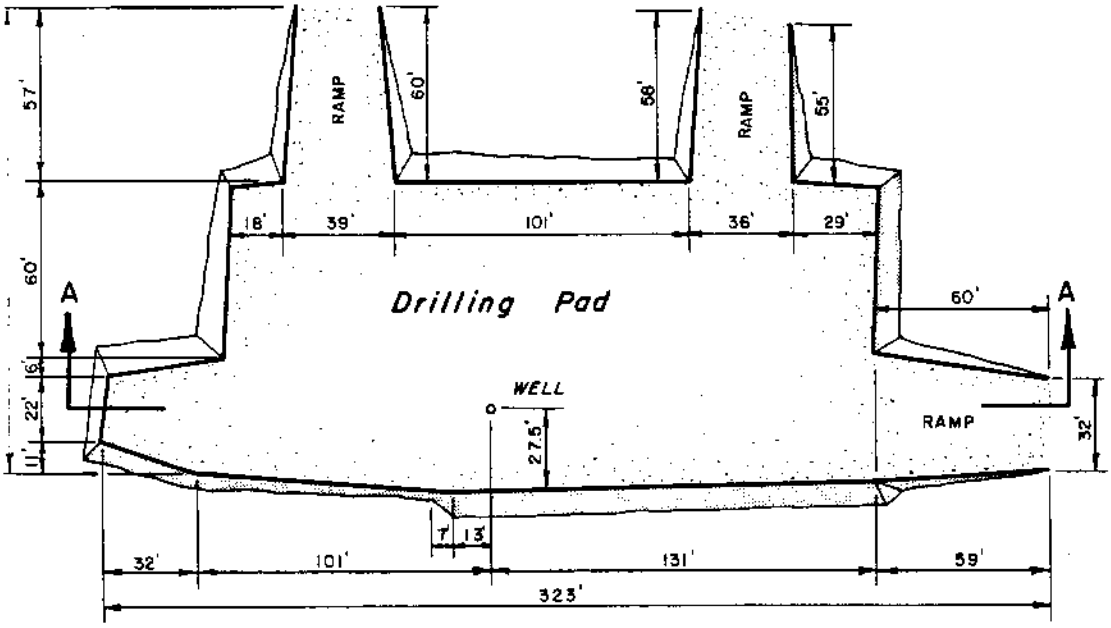
SE1/4 PROTRACTED SEC.23 T22 N.,R17W UMIAT MERIDIAN, AK

Surveyed for

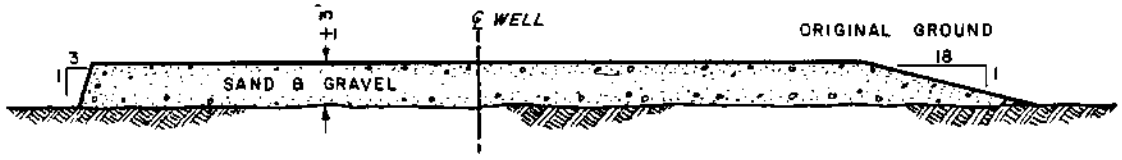
HUSKY OIL
N.P.R. OPERATIONS INC.

Surveyed by

Bell, Herring and Associates
ENGINEERS AND LAND SURVEYORS
801 West Fireweed, Suite 102
ANCHORAGE, ALASKA 99503



PLAN VIEW



SECTION A-A

SOUTH BARROW No. 19 DRILL PAD

OPERATIONS HISTORY

DATE AND FOOTAGE DRILLED AS OF 6:00 A.M.	ACTIVITY
4/15/78	Moving camp and rig to location.
4/16/78	Moved in camp and rigged up same. Rigged up rotary tools. Prepared to cement conductor pipe.
4/17/78	Finished rigging up. Cemented 13-3/8" casing to 80' with 210 sacks of permafrost cement. Circulated 30 sacks of cement. Spudded well April 18, 1978, at 5:00 a.m.
4/18/78 0'	Total Depth: 80'; Mud Weight: 8.7; Viscosity: 40. Installed and welded Braden head. Tested weld to 750 psi. Nippled up diverter line and Hydril. Made up bottom-hole assembly.
4/19/78 318'	TD: 398'; MW: 9.4' Vis: 43. Unplugged flow line. Drilled cement to 70'. Tested Hydril to 250 psi. Drilled out of cement at 80'. Unplugged flow line at 305'. Drilled to 398'.
4/20/78 602'	TD: 1000'; MW: 9.8; Vis: 41. Drilled to 807'. Made short trip. Unplugged flow line. Drilled to 1000'.
4/21/78 330'	TD: 1330'; MW: 9.7; Vis: 40. Drilled to 1060'; surveyed. Tripped for bit. Changed out lower kelly cock and saver sub. Washed 30 feet to bottom. Drilled to 1330'. Circulated and conditioned hole. Made short trip. Circulated and conditioned hole to core. Dropped survey; tripped out steel-line measure.
4/22/78 170'	TD: 1500'; MW: 9.6; Vis: 43. Tripped out steel-line measure. Tripped in with core barrel. Cut Core No. 1: 1330' to 1360'. Recovered 30 feet. Tripped in and reamed rat hole. Drilled to 1500'. Made short trip; tight hole. Conditioned hole for logs.
4/23/78 0'	TD: 1500'; MW: 9.6; Vis: 43. Circulated. Tripped out steel-line measure. Rigged up Schlumberger tools. Ran in with logging tools. Stopped at 1295'. Tripped in with bit. Circulated. Made short trip. Circulated; pulled out of hole. Ran DIL, BHC, and CST.

4/24/78 0'	TD: 1500'. Mixed $CaCl_2$ mud. Ran 38 joints of 9-5/8" casing and set at 1491'. Ran duplex stinger to collar at 1444'. Circulated and cemented with 1,020 sacks of Permafrost cement. Cement in place 4/23/78 at 2:00 p.m. Waited on cement.
4/25/78 0'	TD: 1500'; MW: 10.5; Vis: 35. Nippled up blowout-preventer equipment. Installed 9-5/8" head. Tested weld to 1,000 psi. Finished nippling up blowout-preventer equipment and kill line. Made up flare and blow down lines.
4/26/78 0'	TD: 1500'; MW: 10.4; Vis: 35. Finished nipple up. Tested blowout-preventer equipment, rams, choke manifold, and kill line to 3,000 psi. Tested Hydril to 1,500 psi. Tested casing to 1,600 psi. Drilled float collar, cement, and float shoe.
4/27/78 352'	TD: 1852'; MW: 10.8; Vis: 49. Drilled float collar, cement and float shoe. Drilled to 1510'. Tested formation to 0.61 psi/ft. gradient. Drilled to 1852'. Surveyed, tripped for bit.
4/28/78 187'	TD: 2039'; MW: 11.9; Vis: 47. Finished trip in. Drilled to 2039'. Circulated and conditioned mud 700 to 2,000 units gas and increased mud weight to 11.6 ppg. Started losing mud; lost approximately 75 barrels. Added lost-circulation material and built volume. Increased mud weight to 11.9 ppg. Had 180 units of background gas. Tripped out steel-line measure.
4/29/78 30'	TD: 2069'; MW: 11.6; Vis: 45. Tripped in with core barrel. Circulated and cut mud weight to 11.4. Cleaned out 12 feet of fill. Cut Core No. 2: 2039' to 2069'. Circulated and began to pull out of hole. Well flowed through drill pipe at 1300'. Installed inside blowout-preventer, circulated, ran in hole to bottom and circulated 960 units of trip gas. Raised mud weight to 11.5. Pulled out of hole; started swabbing and flowing at 1260'. Circulated and ran in hole to bottom. Raised mud weight to 11.6. Pulling out of hole. Started swabbing and circulating at 1150'.
4/30/78 106'	TD: 2175'; MW: 11.6; Vis: 46. Pulled out of hole. Hole swabbing. Circulated every three stands. Laid down core and core barrel; full recovery (30'). Ran in hole. Reamed core hole. Drilled. Tripped for Bit No. 5. Ran in hole; cleaned 20 feet of fill and circulated. Drilled and circulated.

5/1/78 0'	TD: 2175'; MW: 11.6; Vis: 46. Circulated; pulled out of hole to shoe. Bridge at 2050' and 1990'. Circulated; made short trip to 1800'. Circulated; pulled out of hole, steel-line measured. Ran DLL/MSFL: 2173' to 1491'; CNL/FDC/GR: 2176' to 1490'; Velocity Survey: total depth to 300'; BHC-Sonic/GR: 2170' to 1490'; Dipmeter: 2173' to 1480'. Shot 45 sidewall cores: 2153' to 1585', recovered 37. Ran in hole. Cut and slipped drill line.
5/2/78 0'	TD: 2175'; MW: 11.6; Vis: 45. Tripped in and circulated. Tripped out and laid down drill collars. Pulled wear bushing and installed 7" rams. Ran 55 joints of 7", 38#, S-95 Buttress casing with the shoe at 2161', duplex float collar at 2122', and FOs at 1288' and 1204'. Stabbed into duplex collar and pumped 15 barrels of water with 2% Howco Cla-Sta, followed by 103 sacks of Class "G" cement with 2% calcium chloride. Displaced with two barrels of water and 10.5 barrels of mud. Cement in place 5/2/78 at 1:18 a.m. Tripped out, checking FOs at 1288' and 1204'.
5/3/78 0'	TD: 2175'; MW: 11.6; Vis: 45. Prepared to mix Arctic Pack. Picked up blowout-preventer stack and set 7" casing slips and packoff. Cut off 7" stub, installed tubing spool, and tested to 3,000 psi. Rigged up return line from 7" x 9-5/8" annulus. Tripped in with packer and FO arms. Checked FOs at 1204' and 1288'. Tested operation and pressure tested 7" cement job to 2,000 psi. Reopened FO at 1288' and pressure tested to 650 psi (equivalent fracture gradient of 1.04 psi/ft.) with no leak off. Closed FO and picked up to FO at 1204'. Cleaned suction pit and prepared to mix Arctic Pack.
5/4/78 34'	TD: 2209'; MW: 10.9; Vis: 43. Cleaned suction tank. Mixed Arctic Pack. Water washed annulus with 87 barrels of water. Pumped two barrels of pre-mix spacer and 45 barrels of gelled Pack. Displaced with 6.6 barrels of mud. Had 1% excess water in final returns. Closed FO and tested to 2,000 psi. Tripped out and laid down tools. Changed kelly. Tripped in steel-line measure with bit. Top of cement at 2120'. Conditioned mud. Drilled out cement, float collar, and shoe. Drilled 10 feet of hole. Tested formation to 0.61 psi/ft. gradient. Drilled to 2209'. Circulated and tripped for core barrel. Picked up core barrel.
5/5/78 36'	TD: 2245'; MW: 10.9; Vis: 43. Tripped in with core barrel. Cut Core No. 3: 2209' to 2217'. Recovered four feet. Tripped in for Core No. 4:

2217' to 2230'. Recovered nine feet. Tripped in for Core No. 5: 2230' to 2245'. Recovered 15 feet. Laid down core barrel. Picked up drill-stem test tools and tripped in. Picked up manifold. Tested lines to 2,000 psi. Put 500 psi nitrogen cushion in pipe. Prepared to drill-stem test.

5/6/78
0'

TD: 2291'; MW: 11; Vis: 48. Ran Drill-Stem Test No. 1: 2161' to 2245'. Set packer at 2129', opened tool. Pressure to 0 psi in four minutes. Fluid to surface in 10 minutes. Tool open four hours, shut in for six hours. Dropped bar; reversed out. Pulled packer loose and circulated. Broke down manifold. Pulled out of hole. Laid down Howco tools. Tripped in hole, reamed 2209' to 2245'. Drilled ahead.

5/7/78
9'

TD: 2300'; MW: 11; Vis: 48. Drilled to 2300'. Made short trip and conditioned hole. Tripped out. Ran DLL/SP. SP failed. Ran FDC/CNL/GR from 2294' to 2062'. Ran BHC-Sonic/GR from 2296' to 2161'. Microlaterolog would not go into open hole.

5/8/78

PBTD: 2100'; MW: 11.0; Vis: 50. Tripped in. Hit bridge at 2220'; washed and reamed 82 feet. Conditioned hole. Tripped out to log. Ran DLL/SP from 2284' to 2161', ran MLL from 2299' to 2110'. Tripped in open ended. Conditioned hole. Cemented Plug No. 1 with 53 sacks of Class "G" cement with 2% calcium chloride at 15.8 ppg--one barrel of water ahead and behind. Displaced with 13 barrels of mud. Picked up to 2080' and reversed out. Tripped out. Picked up bit and casing scraper. Tripped in to 2000'. Circulated and waited on cement.

5/9/78

PBTD: 2085'; MW: 10.8; Vis: 55. Waited on cement. Tagged cement at 2070'. Cleaned out to 2100'. Circulated and scraped casing 2060' to 2100'. Pulled out of hole. Tripped in with Howco retainer. Set retainer at 2085'. Tested casing to 2,000 psi. Pulled out of hole. Ran CBL log. Cleaned tanks and began mixing completion fluid.

5/10/78

PBTD: 2085'; MW: 11.5; Vis: 32. Rigged up to log and perforate. Mixed $CaCl_2$ completion mud. Tripped in hole to 2085'. Reversed out mud with completion fluid. Circulated and tripped out of hole. Laid down drill pipe and drill collars. Changed pipe rams to 2-7/8". Picked up 68 joints of 2-7/8" tubing and stood back in derrick. Tested blowout-preventer and Hydril. Rigged up Schlumberger to perforate and log.

5/11/78 PBTD: 2085'. Displaced annulus with nitrogen. Tested Schlumberger lubricator to 500 psi. Perforated interval 2018' to 2044' with four shots per foot. Ran 68 joints of 2-7/8" tubing to 2049'. Landed tubing in hanger with back-pressure valve in place. Moved blowout-preventers, nippled up Christmas tree and tested to 3,000 psi. Tested seals to 3,000 psi. Hooked up choke, flare, and separator lines. Tested choke line to 3,000 psi.

5/12/78 PBTD: 2085'. Began flow testing well. Displaced well with 750 psi nitrogen. Changed out flowline. Alternated flow between casing and tubing. Cleaned up well. Shut in and rigged up Camco. Tested lubricator to 1,500 psi. Ran Sperry Sun gauges to 2001'. Blew down well for six hours. Shut well in for pressure buildup.

5/13/78 PBTD: 2085'. Well shut in at 5:30 a.m. for buildup. Shut in well for 13-1/2 hours. SIBHP = 962.8 psia. Opened well to flow for four-point test at 7:00 p.m.

Production Test #1 (Calculated) (Appendix III-1 & III-8)

Choke	Rate	Pressure
16/64"	1.17 MMCFD	924.2 psia
22/64"	2.188 MMCFD	858.5 psia
26/64"	3.191 MMCFD	779.4 psia
29/64"	3.687 MMCFD	724.5 psia

Calculated AOFP: 7.22 MMCFGPD
Gas Gravity: 0.611
Dry gas production throughout.
Shut in for final buildup at 5:00 a.m.

5/14/78 PBTD: 2085'. Well shut in for bottom-hole pressure buildup. Shut in for 25 hours. Bottom-hole pressure at 25 hours: 959.2 psia.

5/15/78 Well shut in for bottom-hole pressure buildup. Shut in bottom-hole pressure after 49 hours: 962.6 psi.

5/16/78 PBTD: 2085'. Pulled out of hole with tubing to 500'. Well shut in for 51 hours. Final bottom-hole pressure: 962.7 psi. Pulled out of hole with pressure tools, making gradient stops at 2012', 1987', 1937', 1437', 937', 437', and surface. Rigged down Camco and Sperry Sun. Rigged up and killed well with 11.0 ppg calcium chloride brine. Circulated and checked for flow. Set tubing back-pressure valve. Removed test

tree. Set and tested blowout-preventer equipment to 3,000 psi, Hydril to 1,500 psi. Pulled out of hole with tubing. Ran Baker Model K retainer and set at 1968'. Tested to 2,000 psi. Cut brine weight to 10.8 ppg.

5/17/78 PBTD: 2085'. Displaced mud at 500' with 10.8 ppg calcium chloride completion fluid. Ran 64 joints of 2-7/8" tubing with Baker setting tool to 1929'. Landed tubing with back-pressure valve in place. Nippled down blowout-preventer. Installed Christmas tree. Tested tree bonnet and seals to 3,000 psi. Filled tree with alcohol and water. Cleaned mud tanks. Began rigging down.

Rig released May 16, 1978, at 12:00 midnight.

5/18/78 Began rig move to Barrow Well No. 6. Damaged and repaired skid on mud room. Loaded out two Herc loads.

5/19/78 Continued rig down and move. Set rig on mats at South Barrow No. 6 location. Covered all openings with plywood. Hooked up electricity to red warning lights in the derrick. Cleaned No. 19 location. Moved miscellaneous rig parts to NARL.

DRILLING TIME ANALYSIS

SOUTH BARROW WELL NO. 19 (EAST AREA)

BRINKERHOFF SIGNAL, INC., RIG 31

Spudded 4/18/78, Rig released 5/16/78

Total Depth: 2,300 Feet

DRILLING TIME ANALYSIS (HOURS) - HUSKY NPR OPERATIONS, INC. SOUTH BARROW WELL NO. 19

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
4-15	24																								Moved Camp and Rig from No. 17 Location
4-16	12									¾	6¾												4½		Set Conductor Casing
4-17											8	16													Preparing to Spud
4-18		10	3		½			½				4	½										5½	Drilling Cement	Spudded Well at 5:00 a. m.
4-19		18½		3½	¾																		1½	Drilling	
4-20		17		5	½																		1½	Drilling	
4-21		2¾	1	10¾				2¾									5						1¾	Tripping	Core No. 1: 1330' - 1360'
4-22		1¾		9½				5	6														1¾	Circulating	Ran Schlumberger Wireline Log
4-23				3½				3		7½	10													Running Casing	
4-24											6	18												Waiting on Cement	
4-25												8	16											Nipple Up BOP	
4-26		17½		2	½			1					3											Drilling Cement	
4-27		7¾		4½				10¾				1												Tripping	
4-28				7¾				11									4½						1	Tripping	Core No. 2: 2039' - 2069'
4-29			1½	11½	¼			5½															5½	Circulating	

DRILLING TIME ANALYSIS (HOURS) - HUSKY NPR OPERATIONS, INC. SOUTH BARROW WELL NO. 19

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
4-30		3¼	¾	3¼				5¼	11½															Circ	
5-1				9¼				1¾	4	7½													1½	Trip	
5-2				2				1½		½		17	3											Nipp	
5-3				3½				1¼		1													18¼	Mixi	
5-4		4		10¼				4½									3						2¼	Trip	Ran Schlumberger Wireline Logs
5-5		1¼	1¼	5¾				½										15¼						Drill	
5-6		6¾		1½				4½	11¼															Drill	
5-7			1	4¼				6	12¾															Logg	
5-8			¼	7¾				1¾	3½		9								¼				1½	Waiti	Core No. 3: 2209' - 2217' Core No. 4: 2217' - 2230'
5-9				4½				4															15½	Clear	Core No. 5: 2230' - 2245' DST No. 1: 2161' - 2245'
5-10				4½								13	2½										4	Perf	Ran Schlumberger Wireline Logs
5-11									½			4	3½					8½					7½	Displ Nitr	
5-12																							24	Test	Ran CBL Log
5-13																							24	Testi	
5-14																							24	Test	

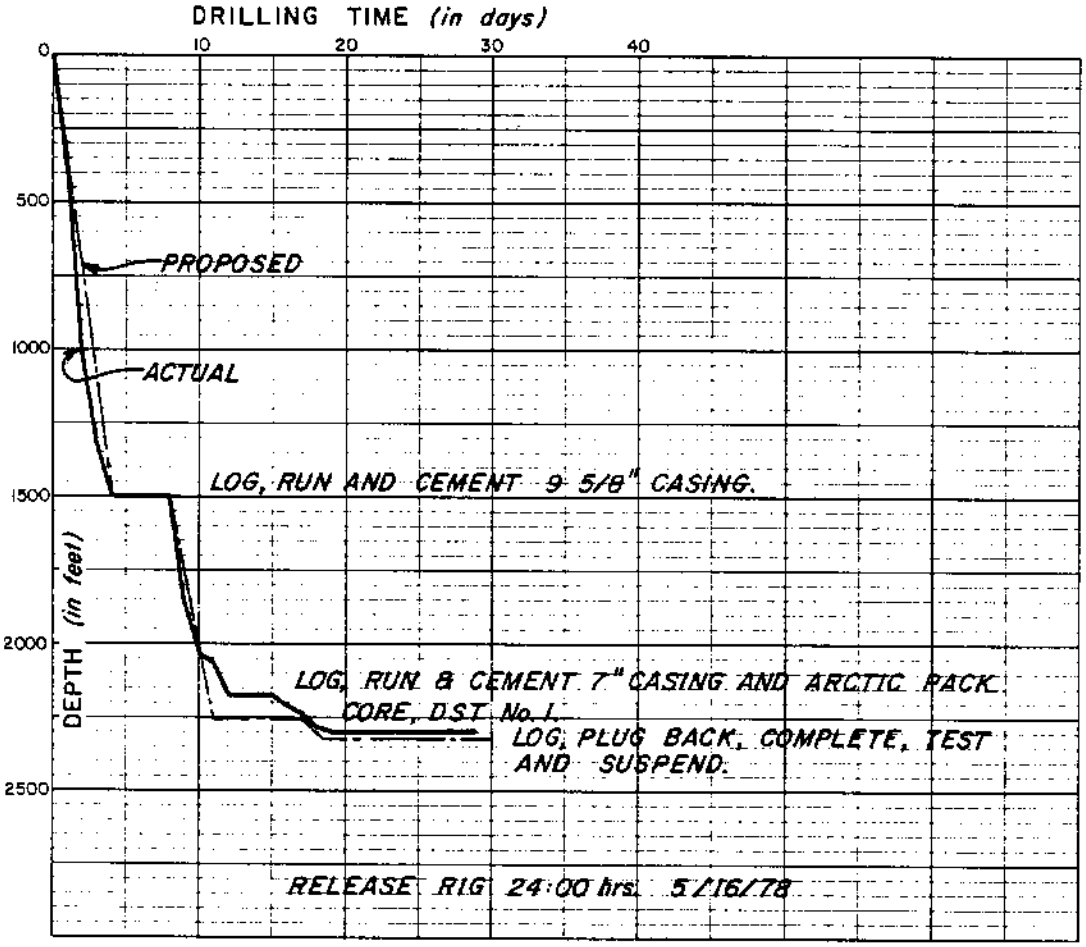
Operating: 2018' - 2044'

Tubing with

Production Test No. 1

LLING TIME ANALYSIS (HOURS) - HUSKY NPR OPERATIONS, INC. SOUTH BARROW WELL NO. 19 Page 3 of 3

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
								3	1			5½	1½										13	Testing	
	5½			6									½										12	Testing	Rig Released at 12:00 p. m.
	24																							Rigging Down	
	24																							Rigging Down	
																							24	Moved Rig to Barrow No.6	
	39½	8¾		2½		-0-		50½		39¾		30½		-0-			12⅛		¼		-0-		194½		
	50¼	120¼		-0-		73½		17¼		86½		-0-		-0-			23¾		-0-		-0-				



SOUTH BARROW No. 19

1320' FEL and 1320' FSL
Sec. 23, T. 22 N., R. 17 W., U.M.
PAD LEVEL 12' Est.
K.B. 30' Est.

HUSKY OIL *N. P. R. Operations*

NATIONAL PETROLEUM RESERVE - ALASKA

DRILLING TIME CURVE

DRILLING MUD RECORD

ARCTIC DRILLING SERVICES

COMPANY Husky Oil NPR Operations, Inc. STATE Alaska CASING PROGRAM: 13 3/8 inch at 80 ft.

WELL South Barrow Well No. 19 COUNTY North Slope 9 5/8 inch at 1491 ft.

CONTRACTOR Brinkerhoff Signal, Inc. LOCATION NPRA SEC 23 TWP 22N RNG 17W 7 inch at 2161 ft.

STOCKPOINT _____ DATE _____ ENGINEER Forman and Rintoul TOTAL DEPTH 2300 ft.

DATE	DEPTH	WEIGHT	VISCOSITY		Yp	GELS	pH	FILTRATION			FILTRATE ANALYSIS				SAND	RETORT			CEC	REMARKS AND TREATMENT
1978	feet	lb/gal	Sec API @ °F	PV @ °F		10 sec/ 10 min	Strip ☐ Meter ☐	ml API	HTHP @ °F	Cake 32nds	Pm	Pf/Mf	Cl ppm	Ca ppm	%	Solids %	Oil %	Water %	Mud, me/ml	
4/18	0	8.7	40	8	14	4/6	9.5	15		1	.7		1,500	0	0	3	0	87		Mixed spud mud.
4/19	398	9.4	43	12	8	1/4	9.5	14		1	.8		1,000	0	0	6	0	94		Drilling.
4/20	970	9.8	41	14	6	2/5	8.5	13.5		2	.3		1,000	60	0	10	0	90		Drilling and diluting.
4/21	1330	9.7	40	13	8	2/5	9.5	13.5		2	.8		1,000	10	0	10	0	90		Flowline plugging; bit balling.
4/22	1500	9.6	43	11	7	1/5	9.0	11		2	.5		2,600	65	0	9	0	91		Cored; tripped to run casing.
4/23	1500	9.6	43	12	8	1/5	9.0	11		2	.4		2,200	70	0	9	0	91		Logged; tripped; logged; ran csg.
4/24	1500	8.6	40	9	12	1/5	8	20		1	0		50M	25M	0	2	0	98		Mixed Calcium Chloride mud.
4/25	1491	10.5	35	9	7	1/3	8.5	16		1	.2		80M	40M	0	6	0	94		Nipple up.
4/26	1491	10.4	35	12	10	1/4	8.5	15		1	.2		80M	40M	0	7	0	93		Nipple up.
4/27	1852	10.8	49	28	8	2/6	8.5	8		2	.1		95M	50M	1/2	11	0	89		Drilling.
4/28	2041	11.9	47	16	8	1/5	8.0	5		1	0		160M	85M	1/2	11	0	89		Drilled Barrow Sand; weight up. Lost 75 barrels 11.6 mud.
4/29	2069	11.6	45	19	7	1/5	8.0	5		2	0		145M	80M	1/2	12	0	88		Coring Barrow Sand; hole swabbing.
4/30	2175	11.6	46	18	8	1/5	8.5	6		2	0		105M	55M	1/4	12	0	88		Drilled to casing point.
5/1	2175	11.6	47	20	10	1/5	8.5	5		2	0		105M	60M	1/2	12	0	88		Logging.
5/2	2162	11.6	45	19	9	1/5	8.5	5		2	0		105M	60M	1/2	12	0	88		Ran and cemented 7" casing.
5/3	2162	11.2	42	18	6	1/5	8.5	6.5		2	0		105M	60M	1/2	12	0	88		Nippling up and testing.
5/4	2207	10.9	43	18	6	2/8	8.5	7		2	0		105M	50M	1/2	13	0	87		Arctic Packed; built mud volume.
5/5	2243	10.8	45	20	8	2/6	8.5	8		2	0		70M	39M	1/4	13	0	87		Coring Sag River Sand.
5/6	2286	11.0	48	20	8	2/8	8.5	8		2	0		70M	39M	1/4	13	0	87		Ran DST; killed well. Drilled.
5/7	2300	11.0	48	20	8	2/8	8.5	8		2	0		70M	39M	1/4	13	0	87		Drilled to TD. Logged.
5/8	2300	11.0	50	20	8	2/8	8.0	9		3	0		65M	36M	1/4	14	0	86		Set bottom plug. WOC.
5/9	2085	10.8	55	20	14	5/15	9.5	10		3	.8		62M	35M	1/4	13	0	87		Set bottom plug; tagged; cleaned pits.
5/10	2085	11.5	32																	Mixed Calcium Chloride; ran tubing.
5/11	2085	11.5	32																	Nipple up and tested tree.
5/12	2085	11.5	32																	Tested.
5/13	2085	11.5	30																	Ran four-point test.
5/14	2085	11.5	30																	Shut in well (36 hours).
5/15	2085	11.5	30																	Well shut in.
5/16	2085	11.5	30																	Killed well with 11.5 brine.
																				Displaced top 500' with a 10.8 lb/gal $CaCl_2$ brine.

BIT RECORD

SHEET 1 OF 1

COUNTY	FIELD	STATE	SECTION	TOWNSHIP	RANGE	SPUD	US	UNDER INTER	SET SAND STRING
North Slope Borough	South Barrow Gas Field	Alaska	23	22N	17W				

CONTRACTOR	RIG NO	LEASE	WELL NO	COMPANY	TOOL PUSHER
		NPRA	South Barrow 19	Husky Oil Company	

MAKE RIG	TYPE	RIG POWER	PUMP POWER	BOILER'S-NO. RTD. HP.	PUMP NO. 1	LINER	PUMP NO. 2	LINER

DRILL PIPE	TOOL JOINT TYPE	DRILL COLLARS	O.D.	I.D.	LENGTH	MUD TYPE	SALESMAN

RUN NO.	SIZE	MAKE	TYPE	JET SIZE	SERIAL	DEPTH OUT	FEET	HOURS	FEET PER HOUR	ACCUM. DRLG. HOURS	WT. 1000 LBS	RPM	VERTICAL DEV.	PUMP PRESS.	PUMP OPER. ATTIN	SPM 1	SPM 2	MUD WT	MUD VIS	MUD W.L.	DULL T	DULL B	DULL G	DULL OTHER	REMARKS
1	12¼	Smith	DSJ	3/14	120DA	1060	1060	35.5	31	36.5	15	110	1½	800		72	72	9.2	40		2	2	I		
2	12¼	Smith	DSJ	3/14	214FP	1330	270	11.5	27	47	15	110	1½	800		75	75	9.4	40		1	1	I		
CH1	8½	Chris	D1A		7563775	1358	28	4	7	51	13	60		750		55	55	9.7	41						
RR2	12¼	Smith	DSJ	3/14	214FP	1500	142	3.5																	
3	8½	Reed	S11J	3/12	229116	1872	372	18.5	20	72	20	100	1½	1300							5	6	I		
4	8½	HTC	X3A	3/12	JM151	2039	166	5.5	33	77.25	20	100	1½	1300							2	1	I		
RR1	8½	Chris	MC-201		753677	2068	29	4.25	9	81.5		60/70	1½	1000											
RR4	8½	HTC	X3A	3/12	JM181	2126	58	5.75	10	87.25	20	100									6	4	I		
5	8½	HTC	X3A	3/12	RM596	2176	49	3.25	15	90.5	20	100		600							2	2	I		
6	5 5/8	Smith	V2		61569	2209	34	3													1	1	IN		
CH2	5½	Chris	MC22		7563772	2217	8	1			12	50		700		55									
						2230	13	1.75			12	50				55									
						2245	15	1.25			12	50				55									
RR6	5 5/8	Smith	V2		61569	2300	55	8	6.8	11	20	80		500		73		11	41	8	2	2	I		

INTRODUCTION

After the 1976 drilling season, casing requirements were reviewed and design of casing strings standardized. Every effort was made to minimize weight and grade changes for simplicity, cost effectiveness, and to reduce chances of error during handling and running operations. Casing sizes were selected to accommodate designs for wells from 2,000' to 20,000'. Steel grade selection was the controlling factor on design with low hardness (Rockwell C24-28) steel being selected for Arctic application and possible H_2S environment. Below is listed casing sizes and design criteria required by Husky:

		YIELD STRENGTH (PSI)		MINIMUM PRESSURE REQUIREMENT (PSI)		
SIZE[1]	WEIGHT	MIN.	MAX.	COLLAPSE	BURST	CONNECTION
20"	133#/ft.	55,000	80,000	1,500	3,050	STC
13-3/8"[2]	72#/ft.	95,000	110,000	3,450	5,350	BTC
9-5/8"[3]	53.5#/ft.	95,000	110,000	8,850	7,900	BTC
9-3/4"[3]	59.2#/ft.	95,000	110,000	9,750	8,540	BTC
[illegible]	[illegible]	80,000	95,000	[illegible]	[illegible]	[illegible]

e to be within API requirements unless adjustment
ecessary to meet ID requirements.
to 12.25".
to 8.50".

(1) OD tolerance
absolutely r
(2) Special drift
(3) Special drift

e additional requirements primarily to assure that the steel
allurgical properties for Arctic applications and resistance
ittlement.

The following ar
exhibits the met
to hydrogen emb

t is 13-3/8" OD and smaller to be quenched and tempered.

1. All pipe tha

" "V" notch tests on two random samples per 50 tons per
mum acceptance of 15 ft.-lb.@-50°F. Furnish test reports

2. Run Charpy
heat. Mini
with order.

testing normally required for API approved pipe.

3. Perform all

t reports for ladle analysis, quantitative analysis, and all
as per API requirements.

4. Furnish tes
check tests

following handling requirements were made:

In addition, the

t be of same steel grade as pipe body.

1. Collars mus

PI modified thread compound on mill-installed collar before

2. Apply an A
bucking on

3. Inspect at mill using Tuboscope's Amalog IV or equivalent on 9-3/4" and smaller, and at least magnetic particle on 13-3/8" and 20". All pipe to have special and area inspection together with full length API drifting. [Note special drifting requirements.]

4. Apply Arctic grade grease on all connections before installing thread protectors.

5. Install closed-end type thread protectors. Plastic plugs can be used to secure wrench openings in protectors.

6. Buck up thread protectors with impact wrench. Both mill and third party inspection personnel should observe the installation of thread protectors.

7. Palletize or containerize the tubulars, if possible, prior to shipment from mill. Do not haul pipe like cordwood in gondola railroad cars.

8. All pipe to be Range 3.

9. No "V" notching or metal stenciling on pipe body or collars.

Casing programmed for South Barrow Well No. 19 was as follows: 13-3/8" conductor at ±110'; 9-5/8" at 1500'; 7" at 2255'; 2-7/8" production tubing should the well be completed. Actual casing run was 13-3/8" at 80', 9-5/8" at 1492', 7" at 2161', and 2-7/8" tubing hung at 1929'.

The 9-5/8" x 7" annulus was displaced with Arctic Pack from the FO in the 7" casing at 1204' back to the surface. This was to prevent collapse of the 7" casing by the mechanism of freezing a non-freezing fluid in the annulus between the 9-5/8" and 7" casing strings throughout the zone of permafrost.

CASING OR LINER CEMENT JOB

Lease National Petroleum Reserve Well So. Barrow Well No. 19 Date April 16, 1978

Size Casing 13 3/8" Setting Depth 80' Top (liner hanger) _____

Hole Size 20 " Mud Gradient _____ Viscosity _____

Casing Equipment

_____ shoe, _____ float located _____ feet

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

and _____ feet

_____ centralizers located _____

_____

_____ scratchers located _____

_____

Liner hanger and pack off (describe) _____

_____

Miscellaneous (baskets, etc.) _____

_____

Cement (around open ended casing through 1" LP on the annulus)

	No. Sacks	Brand	Type	Additives	Slurry Weight	Slurry Volume
(1)	210	Permafrost			14.2	
(2)						

Cement through (DV, FO) Collar at _____ feet

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

Cementing Procedure (around shoe) (cross out where necessary)

Circulated Dry bbls @ _____ BPM, pumped in _____ (cu. ft.), (barrels) _____ _____ prewash, used bottom plug (yes, no), mixed cement (1) above _____ minutes, cement (2) above _____ minutes, top plug (yes, no) displaced with _____ (cu. ft.), (barrels) in _____ minutes at rate of _____ BPM, CFM, (Bumped plug) (Did not bump plug). Final Pressure _____. Reciprocated pipe _____ feet while (mixing) and (displacing) cement. Displacing time 15 minutes. Had full circulation (full, partial, none, etc.). Completed job at 5:15 ~~a.m.~~, p.m. Circulated 30 sacks.

Cementing Procedure (through (DV, FO) at _____ feet) (cross out where necessary)

Opened (DV, FO) at _____ a.m., p.m., circulated _____ bbls @ _____ BPM, pumped in _____ (cu. ft.), (barrels) _____ prewash, mixed cement (3) above _____ minutes, cement (4) above _____ minutes, dropped closing plug, displaced with _____ (cu. ft.), (barrels) in _____ minutes at rate of _____ _____ BPM, CFM. (Bumped plug) (Did not bump plug). Final Pressure _____ Displacing time _____ minutes. Had _____ circulation (full, partial, none, etc.)

Remarks (Third Stage Job, etc.)

_____

_____

_____

_____

_____

Smith/McGee
Foreman

CASING TALLY
SUMMARY SHEET

DATE: April 23, 1978

FIELD East Barrow Gas Field

LEASE & WELL NO. NPRA -- South Barrow Well No. 19 .. TALLY FOR 9 5/8" CASING

SUMMARY OF PAGE MEASUREMENTS

	NO. OF JOINTS	FEET	.00'S
PAGE 1	38	1488	17
PAGE 2			
PAGE 3			
PAGE 4			
PAGE 5			
PAGE 6			
PAGE 7			
PAGE 8			
PAGE 9			
TOTAL			

SUMMARY OF DEPTH CALCULATIONS

		NO. OF JOINTS	FOOTAGE FEET	FOOTAGE 00'S
	TOTAL CASING ON RACKS	38	1488	17
1	LESS CASING OUT (JTS NOS.	-	-	-
2	TOTAL (1 - 2)	38	1488	17
3	SHOE LENGTH		1	95
4	FLOAT LENGTH		1	75
5	MISCELLANEOUS EQUIPMENT LENGTH			
6	TOTAL CASING AND EQUIPMENT FROM CEMENT HEAD (3 + 4 + 5 + 6)		1491	87
7	LESS WELL DEPTH (KB REFERENCE) (17.40)		1474	47
8	"UP" ON LANDING JOINT		-	-
9				

Weight indicator before cementing: 75,000# ; after slack-off. _____ ; inches slacked off _____

SUMMARY OF STRING AS RUN

WEIGHT	GRADE	THREAD	MANUFACTURER	CONDITION NEW-USED	LOCATION IN STRING	NO. OF JOINTS	FOOTAGE	INTERVAL
53.5	S-95	Buttress	Armco	New	JT NO. 1 THRU NO. 38	38	1488.17	
					JT NO. ___ THRU NO.			
					JT NO. ___ THRU NO.			
					JT NO. ___ THRU NO.			
					JT NO. ___ THRU NO.			
					JT NO. ___ THRU NO.			
					JT NO. ___ THRU NO.			

PAGE 1 OF 1 **CASING TALLY** DATE: April 21, 1978

FIELD East Barrow Gas Field LEASE & WELL NO. NPRA - So. Barrow 19 TALLY FOR 9 5/8 " CASING

JOINT NO.	FIRST MEASUREMENT FEET	FIRST MEASUREMENT .00'S	CHECK MEASUREMENT FEET	CHECK MEASUREMENT .00'S	WT GR.
1	43	87			
2	40	08			
3	36	95			
4	38	84			
5	36	00			
6	41	30			
7	38	75			
8	37	66			
9	36	21			
0	39	98			
TOTAL A	389	64			

JOINT NO.	FIRST MEASUREMENT FEET	FIRST MEASUREMENT .00'S	CHECK MEASUREMENT FEET	CHECK MEASUREMENT .00'S	WT GR.
1	39	60			
2	39	90			
3	35	80			
4	39	18			
5	39	25			
6	41	18			
7	41	05			
8	44	33			
9					
0					
TOTAL D	320	29			

1	36	90			
2	35	53			
3	41	20			
4	39	12			
5	41	30			
6	36	24			
7	39	86			
8	38	04			
9	41	08			
0	39	30			
TOTAL B	388	57			

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

1	37	90			
2	41	08			
3	39	32			
4	38	96			
5	37	75			
6	43	10			
7	35	80			
8	38	63			
9	37	10			
0	40	30			
TOTAL C	389	67			

TOTAL A	389	64		
TOTAL B	388	57		
TOTAL C	389	67		
TOTAL D	320	29		
TOTAL E				
TOTAL PAGE	1488	17		

CASING OR LINER CEMENT JOB

Lease National Petroleum Reserve Well So. Barrow Well No. 19 Date April 23, 1978

Size Casing 9 5/8" Setting Depth 1491.87' Top (liner hanger) _____

Hole Size 12 1/4" " Mud Gradient .499 Viscosity 43

Casing Equipment

1491.87 shoe, 1444.30 float located 47.57 feet

above shoe, 1491.87 (DV, FO) collars located at _____ feet

and _____ feet

Nine _____ centralizers located per drilling prognosis.

_____

_____ scratchers located _____

_____

Liner hanger and pack off (describe) _____

_____

Miscellaneous (baskets, etc.) _____

_____

Cement (around shoe)

	No. Sacks	Brand	Type	Additives	Slurry Weight	Slurry Volume
(1)	1020	Permafrost			14.8	204 Bbls
(2)						

Cement through (DV, FO) Collar at _____ feet

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

Cementing Procedure (around shoe) (cross out where necessary)

Circulated 2 Hours @ 4.2 BPM, pumped in 20 ~~(cu. ft.)~~ (barrels) water

_____ ~~(pre-wash)~~ used bottom plug (~~was~~ no), mixed cement (1) above 34

minutes, cement (2) above _____ minutes, top plug (yes, no) displaced with

_____ (cu. ft.), (barrels) in _____ minutes at rate of _____ BPM, CFM,

(Bumped plug) (Did not bump plug). Final Pressure _____. Reciprocated

pipe _____ feet while (mixing) and (displacing) cement. Displacing time 2

minutes. Had full circulation (full, partial,

none, etc.). Completed job at 2:00 ~~a.m.~~, p.m. Circulated 120 sacks.

Cementing Procedure (through (DV, FO) at _____ feet) (cross out where necessary)

Opened (DV, FO) at _____ a.m., p.m., circulated _____ bbls @ _____ BPM, pumped in

_____ (cu. ft.), (barrels) _____ prewash, mixed cement (3) above

_____ minutes, cement (4) above _____ minutes, dropped closing plug, dis-

placed with _____ (cu. ft.), (barrels) in _____ minutes at rate of _____

_____ BPM, CFM. (Bumped plug) (Did not bump plug). Final Pressure _____.

Displacing time _____ minutes. Had _____ circulation

(full, partial, none, etc.)

Remarks

Water temperature: 70°F. Slurry temperature: 56°F.

McGee/Smith

Foreman

CASING TALLY
SUMMARY SHEET

DATE: May 2, 1978

FIELD East Barrow Gas Field LEASE & WELL NO. NPRA -- South Barrow Well No. 19 TALLY FOR 7 " CASING

SUMMARY OF PAGE MEASUREMENTS			
	NO OF JOINTS	FEET	00'S
PAGE 1	50	1962	97
PAGE 2	5	187	85
PAGE 3			
PAGE 4			
PAGE 5			
PAGE 6			
PAGE 7			
PAGE 8			
PAGE 9			
TOTAL			

SUMMARY OF DEPTH CALCULATIONS				
		NO OF JOINTS	FOOTAGE FEET	00'S
1	TOTAL CASING ON RACKS			
2	LESS CASING OUT (JTS NOS.			
3	TOTAL (1 - 2)	55	2150	82
4	SHOE LENGTH		1	90
5	FLOAT LENGTH		1	70
6	MISCELLANEOUS EQUIPMENT LENGTH		7	40
7	TOTAL CASING AND EQUIPMENT FROM CEMENT HEAD (3 + 4 + 5 + 6)		2161	82
8	LESS WELL DEPTH (KB REFERENCE)		17	40
9	"UP" ON LANDING JOINT		2144	42

Weight indicator before cementing: 64,000 ; after slack-off: _____ ; inches slacked off _____

SUMMARY OF STRING AS RUN								
WEIGHT	GRADE	THREAD	MANUFACTURER	CONDITION NEW-USED	LOCATION IN STRING	NO OF JOINTS	FOOTAGE	INTERVAL
38#	S-95	Buttress		New	JT NO. 1 THRU NO. 55	55	2150.82	
					JT NO. THRU NO.			
					JT NO. THRU NO.			
					JT NO. THRU NO.			
					JT NO. THRU NO.			
					JT NO. THRU NO			
					JT NO. THRU NO			

PAGE 1 OF 2 **CASING TALLY** DATE: May 2, 1978

FIELD East Barrow Gas Field LEASE & WELL NO. NPRA - So. Barrow 19 TALLY FOR 7 " CASING

JOINT NO.	FIRST MEASUREMENT FEET	FIRST MEASUREMENT .00'S	CHECK MEASUREMENT FEET	CHECK MEASUREMENT .00'S	WT GR.
1	35	59			
2	40	47			
3	39	53			
4	35	21			
5	42	70			
6	42	11			
7	38	90			
8	37	62			
9	42	49			
0	42	55			
TOTAL A	397	17			

JOINT NO.	FIRST MEASUREMENT FEET	FIRST MEASUREMENT .00'S	CHECK MEASUREMENT FEET	CHECK MEASUREMENT .00'S	WT GR.
1	41	70			
2	36	18			
3	42	06			
4	40	38			
5	41	35			
6	36	68			
7	38	76			
8	36	91			
9	35	08			
0	37	93			
TOTAL D	387	03			

1	36	30			
2	40	00			
3	41	68			
4	38	95			
5	43	05			
6	36	27			
7	36	35			
8	38	02			
9	43	25			
0	35	69			
TOTAL B	389	56			

1	40	20			
2	38	45			
3	42	33			
4	36	29			
5	36	30			
6	41	48			
7	42	35			
8	37	42			
9	37	37			
0	36	10			
TOTAL E	388	29			

1	41	95			
2	36	90			
3	38	80			
4	42	33			
5	41	28			
6	42	40			
7	37	65			
8	42	02			
9	42	06			
0	35	53			
TOTAL C	400	92			

TOTAL A	397	17		
TOTAL B	389	56		
TOTAL C	400	92		
TOTAL D	387	03		
TOTAL E	388	29		
TOTAL PAGE	1962	97		

PAGE 2 OF 2 **CASING TALLY** DATE: May 2, 1978

FIELD East Barrow Gas Field LEASE & WELL NO. NPRA - So. Barrow 19 TALLY FOR 7 " CASING

JOINT NO.	FIRST MEASUREMENT FEET	FIRST MEASUREMENT .00'S	CHECK MEASUREMENT FEET	CHECK MEASUREMENT .00'S	WT GR.
1	37	22			
2	37	66			
3	36	25			
4	39	19			
5	37	53			
6					
7					
8					
9					
0					
TOTAL A	187	85			

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

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

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

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

TOTAL A	187	85		
TOTAL B				
TOTAL C				
TOTAL D				
TOTAL E				
TOTAL PAGE	187	85		

CASING OR LINER CEMENT JOB

Lease National Petroleum Reserve Well So. Barrow Well No. 19 Date May 2, 1978

Size Casing 7" Setting Depth 2161.82 Top (liner hanger) _____

Hole Size 8 1/2 " Mud Gradient .582 Viscosity 42

Casing Equipment

2161.82 shoe, _____ float located 35.59 feet

above shoe, _____ (DV, FO) collars located at 1288 feet

and 1204 feet.

_____ centralizers located as per program.

_____ scratchers located _____

Liner hanger and pack off (describe) _____

Miscellaneous (baskets, etc.) _____

Cement (around shoe)

	No. Sacks	Brand	Type	Additives	Slurry Weight	Slurry Volume
(1)	103	Permafrost	Class "G"	2% CaCl[illegible]	[illegible]	[illegible]

(2) _____

O) Collar at _____ feet

Cement through (DV, F

Brand	Type	Additives	Slurry Weight	Slurry Volume

	No. Sacks
(3)	
(4)	

Cementing Procedure (around shoe) (cross out where necessary)

Circulated 150 bbls @ 5 BPM, pumped in 15 ~~(cu. ft.)~~; (barrels) water

_____ prewash, used bottom plug (yes, no), mixed cement (1) above 5

minutes, cement (2) above _____ minutes, top plug (yes, no) displaced with

_____ (cu. ft.), (barrels) in _____ minutes at rate of 2 BPM, ~~CFM;~~

(Bumped plug) (Did not bump plug). Final Pressure _____. Reciprocated

pipe _____ feet while (mixing) and (displacing) cement. Displacing time 5

minutes. Had full circulation (full, partial,

none, etc.). Completed job at 1:18 a.m., ~~p.m.~~.

Cementing Procedure (through (DV, FO) at _____ **feet)** (cross out where necessary)

Opened (DV, FO) at _____ a.m., p.m., circulated _____ bbls @ _____ BPM, pumped in

_____ (cu. ft.), (barrels) _____ prewash, mixed cement (3) above

_____ minutes, cement (4) above _____ minutes, dropped closing plug, dis-

placed with _____ (cu. ft.), (barrels) in _____ minutes at rate of _____

_____ BPM, CFM. (Bumped plug) (Did not bump plug). Final Pressure _____.

Displacing time _____ minutes. Had _____ circulation

(full, partial, none, etc.)

Remarks (Third Stage Job, etc.)

_____

_____

_____

_____

_____

McGee/Brown

Foreman

PAGE 1 OF 1 TUBING TALLY DATE: May 16, 1978

FIELD East Barrow Gas Field LEASE & WELL NO. NPRA - So. Barrow 19 TALLY FOR 2 7/8" TUBING

JOINT NO	FIRST MEASUREMENT FEET	.00'S	CHECK MEASUREMENT FEET	.00'S	WT GR.
1	60	31			
2	60	69			
3	60	65			
4	59	61			
5	59	22			
6	67	96			
7	60	45			
8	60	27			
9	59	43			
0	59	58			
TOTAL A	608	17			

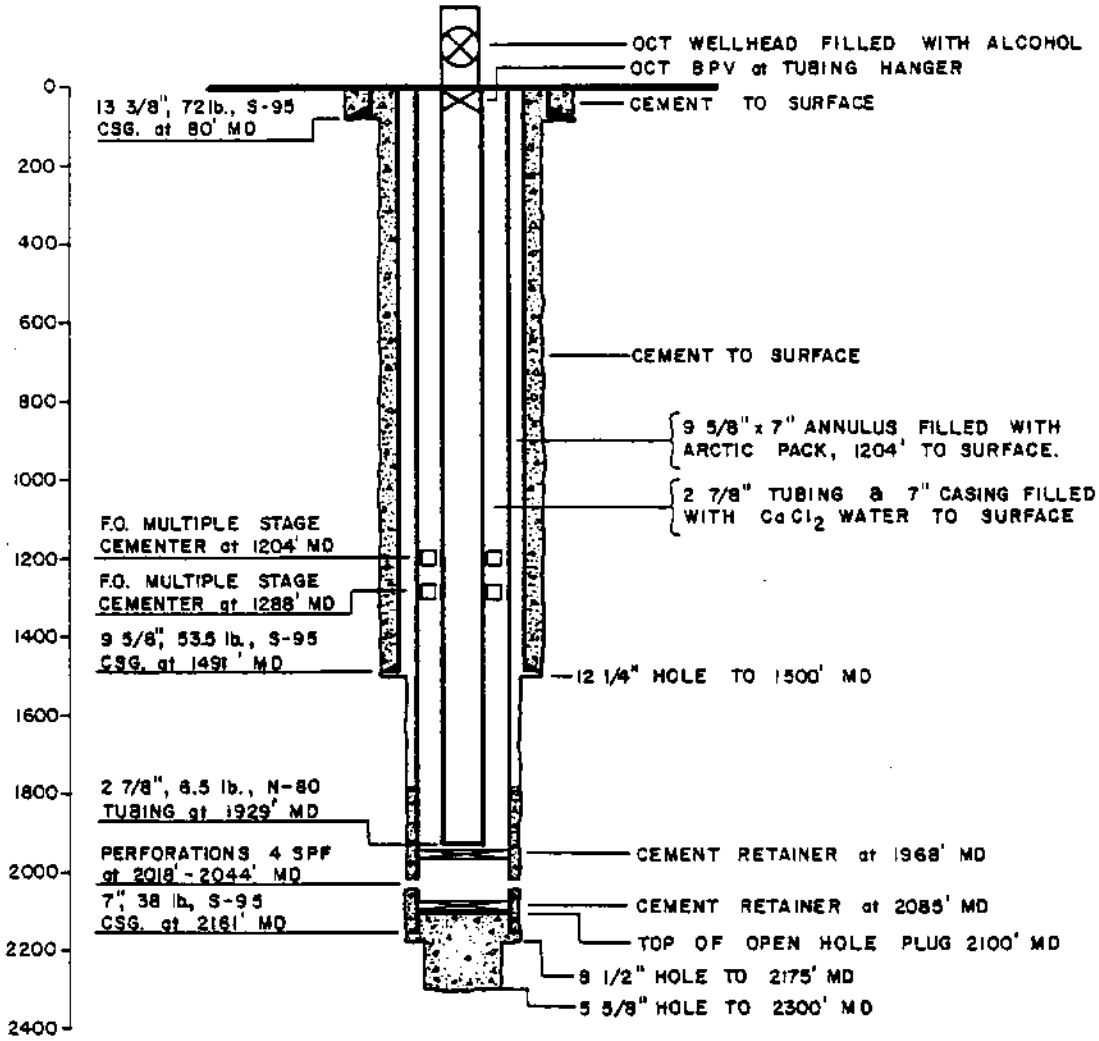
JOINT NO.	FIRST MEASUREMENT FEET	.00'S	CHECK MEASUREMENT FEET	.00'S	WT GR.
1	61	42			
2	59	00			
3	59	84			
4	61	40			
5					
6					
7					
8					
9					
0					
TOTAL D	241	66			

1	63	14			
2	58	13			
3	58	91			
4	58	58			
5	59	20			
6	56	78			
7	57	53			
8	59	47			
9	57	49			
0	60	91			
TOTAL B	590	14			

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

1	60	59			
2	58	00			
3	57	48			
4	59	27			
5	59	29			
6	60	80			
7	57	13			
8	62	81			
9	61	68			
0	61	90			
TOTAL C	598	95			

TOTAL A	608	17		
TOTAL B	590	14		
TOTAL C	598	95		
TOTAL D	241	66		
TOTAL E				
TOTAL PAGE	2038	92		



SOUTH BARROW No. 19

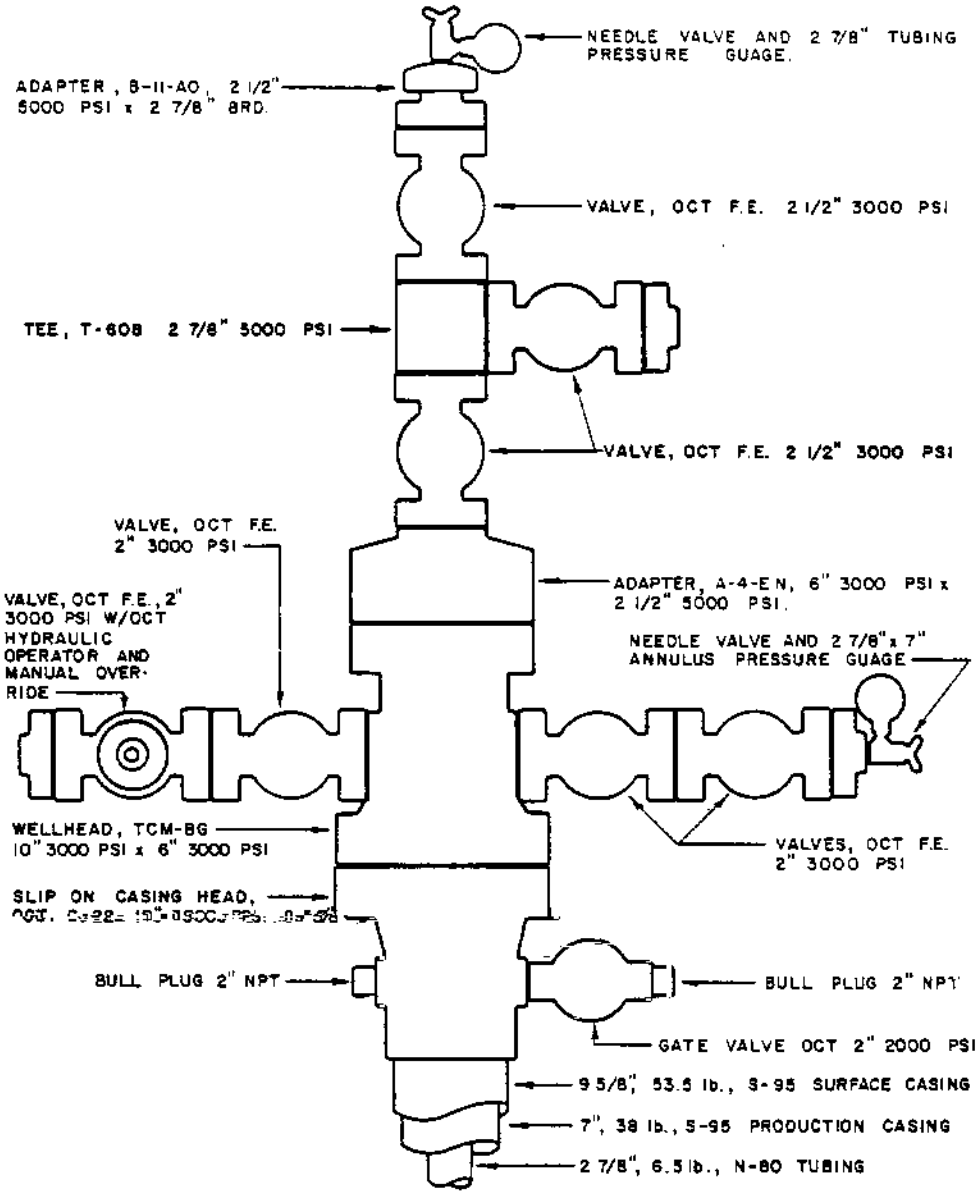
1320' FEL and 1320' FSL
Sec. 23, T. 22 N., R. 17 W., U.M.
PAD LEVEL 12' Est.
K.B. 30' Est.

HUSKY OIL *N. P. R. Operations*

NATIONAL PETROLEUM RESERVE – ALASKA

WELLBORE SCHEMATIC

WELLHEAD SCHEMATIC



SOUTH BARROW No. 19

1320' FEL and 1320' FSL
Sec. 23, T.22 N., R.17 W., U.M.
PAD LEVEL 12' Est.
K.B. 30' Est.

HUSKY OIL *N.P.R. Operations*

NATIONAL PETROLEUM RESERVE - ALASKA

SURFACE EQUIPMENT

ARCTIC CASING PACK

In production wells, wells suspended through summer months, and wells completed for re-entry with temperature recording tools, Baroid Arctic Casing Pack was used between casing strings. It is a stable, highly viscous fluid which will not freeze and collapse casing set in permafrost zones. Its unique gelling characteristics exhibit excellent thermal properties (heat transfer coefficient of approximately 0.1 BTU per hour per square feet per degree F at 32°F). Composition of Baroid Arctic Casing Pack used is as follows for each 100 barrels mixed:

Diesel	82.0 barrels
Water	5.0 barrels
Salt	60.0 ppb per barrel of water
EZ Mul	12.5 ppb
Gel Tone	50.0 ppb
Barite	103.0 ppb

The 9-5/8" x 7" annulus was filled with Arctic Pack in South Barrow Well No. 19 in anticipation of completing the well in a lower zone. The Arctic Pack was displaced through a FO at 1204' in the 7" casing back to the surface.

ARCTIC PACK RECORD

DATE: May 3, 1978

I. JOB SUMMARY

Annulus volume: 9 5/8" x 7 " x 1204'	27.93	bbl
Drill pipe volume: 3 1/2 x 15.5 #/ft x 681 ' + 523' of 4 3/4" X 2 1/16"	6.66	bbl
Total volume of system:	34.6	bbl
Volume of water used in water wash	87.4	bbl
Volume of water pumped at water breakthrough	39.4	bbl
Volume of pack pumped	47	bbl
Volume of pack pumped at breakthrough	35	bbl
Displacement efficiency at breakthrough	100	%
% Water contamination of returns at end of job	1%	%

Remarks (including weather): Good job. Both wash and Pack breakthrough late. Total Geltone content: 58.3 ppb. Weather: +16°F, 14K, 5 miles.

II. PILOT TEST OF FLUIDS

A. Prepack

Retort Data:

% Oil	81	
% Water	5	
% Solids	14	
Weight	10.5	#/gal

Rheology (at 35 °F):

PV	20	cps
YP	8	#/100 ft^2
10 Sec Gel	2	#/100 ft^2
Emulsion Stability	–	volts

Not measured. Est: 2000+

B. Gelled Pack (33.3 #/bbl Geltone added to prepack):

Rheology (at 45 °F):

PV	20	cps
YP	18	#/100 ft^2
10 Sec Gel	8	#/100 ft^2

C. Drilling Mud (prior to displacement with water):

Wt	11.2	#/gal
PV	19	cps
YP	9	#/100 sq ft
10 Sec Gel	1	#/100 sq ft

Remarks: Mixed 60 bbls premix in rig suction tank. Took returns to trip tank. Mixed premix heavy for gradient. Put returns in drums for storage.

III. RELEVANT WELL DATA

Outer casing: 9 5/8" ; 53.5 #/ft
Inner casing: 7" ; 38 #/ft
Drill pipe: 3 1/2" ; 15.5 #/ft
Drill collars..... 4 3/4" X 2 1/16"
Depth of cement sleeve: ..... 1204 ft

Casing annulus volume: ..... 27.93 bbls

Drill pipe volume (includes height to floor) ..... 6.66 bbls
Total system volume ..... 34.6 bbls
Rig pump capacity ..... 17 strokes/bbl
Cementing unit pump capacity ..... 20.29 strokes/bbl

Remarks: Did not downsqueeze. Tested cement and lap to 650 psi over 11.2 ppg mud for 1.02 psi/ft gradient. Tested both FOs to 2000 psi before and after job.

IV. WATER WASH STEP

Volume water pumped ..... 87.4 bbls

Rate ..... 3.72 bbl/min

Volume pumped at water breakthrough (0.5 #/gal drop in weight of mud return) ..... 39.4 bbls

Appearance of water at end of water wash ..... clear

X turbid

muddy

Remarks: Pumped water off truck to rig pump. Water temperature: 35°F. Water weight: 8.4 ppg @ end of wash. Started wash at 1:25 PM. Finished at 1:49 PM.

V. ARCTIC PACK DISPLACEMENT

a. Volume of pre-mix spacer ..... 2 bbl
b. Total volume of gelled pack pumped ..... 45 bbl
c. Total number of (50 lb) sacks of Geltone added ..... 30 sacks
d. Average lb Geltone added per bbl ..... 33.3 lb/bbl
e. Pumping rate ..... 2 bbl/min
f. Total volume of pre-mix and gelled pack pumped at breakthrough ..... 35 bbl
g. Volume of returns dumped into mud system ..... 0 bbl
h. Volumes of fluids used to displace drill pipe ..... 6.6 bbl of mud

\- bbl of -

i. Volume of uncontaminated returns ..... 0 bbl

k. Remarks: Final water: 6% - 1% excess. Prior to displacement: 8% - 3% excess. Started Pack at 2:22 PM. Pack in place at 3:20 PM.

RIG INVENTORY

Draw Works

National T-20, single drum grooved for 1" wireline with 15" double hydromatic brake, automatic breakout and make up catheads, driven by one set of FMC diesel twin 671 engines, 300 HP, through Allison torque converter, all mounted on single skid. One Westinghouse 3YC air compressor driven by main PTO.

Mast

Lee C. Moore, 95' high with 9 foot wide front by spread cantilever. Gross nominal capacity 290,000 lbs. with racking board capacity of 130 stands of 4-1/2" drill pipe (doubles). Mast crown block capable of stringing eight 1" wire lines.

Subbase

Three box sections, two at ground level 8 feet high, 9 feet wide, 37 feet long; center section 8 feet 5 inches high, 9 feet wide and 37 feet long. Clear working space from bottom of rotary beam to bottom of subbase is 14 feet 7 inches. Rotary table to bottom of subbase is 17 feet (add four inches for rig matts).

Rig Matts

Ten 4" x 16' long x 8' wide; fifteen 4" x 24' long x 8' wide.

Traveling Blocks

IDECO, 160 ton, four 1" sheave combination block and hook.

Swivel

EMSCO L-140, 6-5/8" left hand API regular pin, 140 ton capacity.

Bails

Byron Jackson, 2-1/4" x 108', links 250 ton capacity.

Rotary Table

Oilwell 17-1/2" split square drive master bushing 275 ton static load capacity.

Mud Tank

Three section, insulated tank. Capacity shale tank: 75 barrels; capacity middle tank: 100 barrels; capacity suction tank: 112 barrels. Shale tank equipped with shale jet and 16 barrel trip tank. Total capacity: 303 barrels.

Shaker

Single Brandt tandem separator driven by 3 HP, three-phase, 440 volt, 1750 RPM explosion proof electric motor.

Degasser

Drilco, see-flo, driven by 7-1/2 HP, three-phase, 440 volt, explosion proof motor with 1/2 HP, three-phase, 440 volt explosion proof blower.

Desander

Pioneer Model S2-12; capacity: 500 GPM.

Desilter

Pioneer Model T8-6; capacity: 500 GPM.

Mud Mixer

One Dreco, driven by 5 HP, three-phase, 440 volt, 1725 RPM explosion proof motor.

Hopper

One low pressure mud mixing hopper.

Generators

One Caterpillar Model 3406, 210 KW; one Caterpillar, skid mounted in Hercable house, 8' 5" high x 8' 2" wide x 29' 5" long; one Caterpillar Model D-333, 100 KW standby.

Boilers

Two Continental, 40 HP, 120 psi diesel fired skid mounted in Hercable house, 8' 4" high x 8' wide x 35' long.

Steam Heaters

Seven Model 90H Trane steam heaters; three Model 96H Trane steam heaters.

Tongs

Byron Jackson, Type "C", short lever, with heads.

Indicator

(Weight) Cameron, Type "C", up to 400,000 lbs.

56

Indicator

(Rotary Torque) Martin Decker hydraulic piston wheel type with remote gauge at Driller's position.

Indicator

(Tong Torque) Martin Decker, hydraulic piston type with remote gauge.

Mud Box

OKE mud box with 3-1/2" and 4-1/2" rubbers.

Slips

One set for 3-1/2" drill pipe. One set for 4-1/2" drill pipe.

Elevators

One set for 3-1/2" drill pipe, 18 degrees taper. One set for 4-1/2" drill pipe, 18 degrees taper.

Kelly

One square 4-1/4" drive, 4" FH pin, 6-5/8" API regular left hand box. One square, 3-1/2" drive, 3-1/2" IF pin, 6-5/8" API regular left hand box.

Kelly Bushing

VARCO, square drive, 3-1/2" rollers.

Pumps

(Drilling and Cementing) Two Halliburton, HT-400D, single acting piston pumps with Gist Oil Tool API fluid ends, each driven by GMC diesel 8V-71N, 300 HP engines through an Allis-Chalmers torque converter, Model 8FW1801-1 and a twin-disc power shift transmission, Model No. T-A-51-2003. Continuous duty with 5-1/2" API pistons at maximum of 75 SPM will produce 185 GPM for each pump with maximum pressure up to 3,000 psi. Both pumps can be run simultaneously if desired. The discharge mud lines furnished by contractor from pumps to swivel connection is designed for 3,000 psi working pressure. Each pump unit mounted on 8' 4" high x 10' wide x 40' long covered skid.

Air Compressors

One LeRoi 34C mounted on draw works compound. One Ingersoll Rand Model 71-T2-T3011 TM, driven by 10 HP, 440 volt, 1725 RPM explosion proof electric motor.

Water Tanks

One 7' high x 9' wide x 20' long, insulated water tank, mounted in the subbase; capacity: 225 barrels. One 17' 4" long x 6' 4" wide; capacity: 120 barrels.

Fuel Tanks

One 20' long x 8' 6" wide; capacity: 6,000 gallons.

Blowout Preventer Equipment

One ten-inch, 900 dual Shaffer gate LWS with three-inch flanged side outlet one side.

One - ten-inch 900 GK Hydril.
One - ten-inch 900 drill spool with two-inch flanged outlets both sides.
One - set 4-1/2" pipe rams.
One - set 3-1/2" pipe rams.
One - set blind rams.
One - upper kelly cock T1W 6-5/8" regular LH box to pin.
Two - T1W 10,000 psi lower kelly cocks, 4-1/2" XH joints.
Two - T1W 10,000 psi lower kelly cocks, 3-1/2" IF joints.
One - inside preventor, 10,000 lb. Hydril, 4-1/2" XH.
One - inside preventor, 10,000 lb. Hydril, 3-1/2" IF.

Choke Manifold

Three-inch, 3,000 lb., with one two-inch OCT adjustable choke; one two-inch OCT positive choke and space for automatic choke.

Closing Unit

One 80-gallon Hydril closing unit with four nitrogen bottle backup. Four-station Koomey control manifold with four-station air operated remote stations.

Drill Pipe

5,000 feet, 4-1/2", 16.6 lb., Grade E, 4-1/2" XH joints;
5,000 feet, 3-1/2", 15.5 lb., Grade E, 3-1/2" IF joints.

Drill Collars

Nineteen - 6-1/4" x 2-1/4" x 30' four-inch H90 tool joints.
One - 6-1/4" x 2-1/4" x 30' four-inch H90 x 4-1/2" regular bottom collar.
Nineteen - 4-3/4" x 1-3/4" x 30' x 3-1/2" IF x 3-1/2" regular bottom collar.
One - 4-3/4" x 1-3/4" x 30' x 3-1/2" IF x 3-1/2" regular bottom collar.

Subs

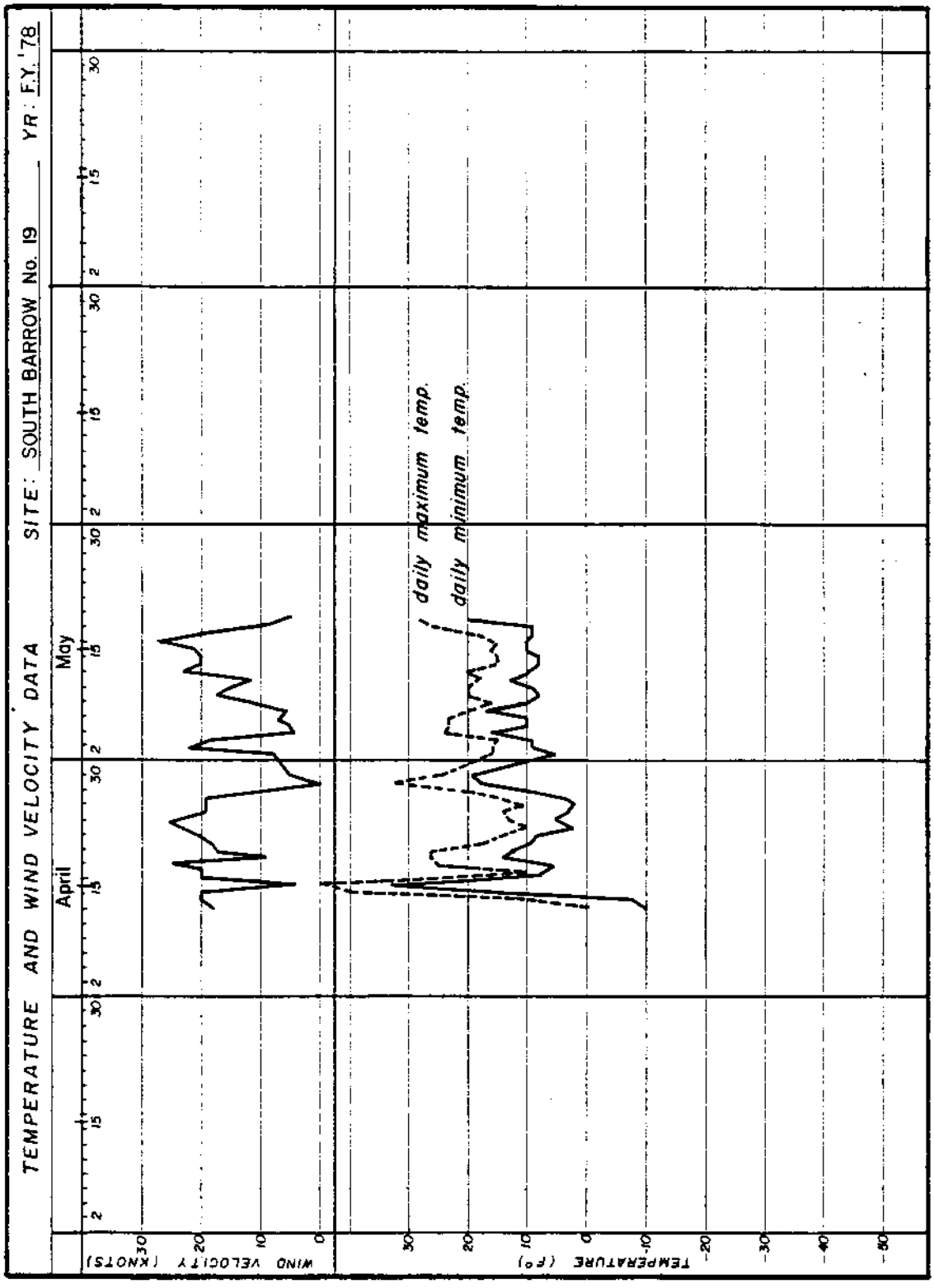
Two - 4-1/2" XH kelly savor subs.
Two-- 3-1/2" IF kelly savor subs.
Two - 4-1/2" XH box to 4" H90 pin (DC crossover).
Two - 4" H90 box to 4-1/2" regular box (bit sub).
Two - 3-1/2" IF box to 2-7/8" API regular box (bit sub).

Forklift

One 966 Caterpillar, equipped with 60-inch forks.

Pipe Racks

One - V door ramp with stairs.
One - Tail walk section, 6' 1" wide x 43" high x 42' long.
Four - Pipe rack sections, 43" high x 4' wide x 28' long.


TEMPERATURE AND WIND VELOCITY DATA
SITE: SOUTH BARROW No. 19
YR: F.Y. '78
April
May
daily maximum temp.
daily minimum temp.
WIND VELOCITY (KNOTS)
TEMPERATURE (F°)

ENGINEERING MEMORANDA

SOUTH BARROW WELL NO. 19

PRODUCTION TEST NO. 1

May 11-14, 1978

This memoranda is a presentation of the reservoir data gathered and reservoir calculations from the production test of the Barrow Sand in the South Barrow Well No. 19. Table I presents basic well and formation data. Table II is a listing of primary analysis results. These are original gas in place, back-pressure analysis, drawdown analysis, pressure buildup analysis, and pressure gradient test analysis. Presented next is a discussion of each analysis. Conclusions and recommendations are followed by data, graphs, and example calculations.

TABLE I - WELL AND FORMATION DATA

1.	Barrow Sandstone, early-middle Jurassic	
2.	Perforations 2018 to 2044 feet at 4 spf	
3.	Gross sand thickness	l = 26 feet
4.	Net pay thickness	h = 16 feet
5.	Bulk porosity in net pay	$\emptyset_B$ = 24.2%
6.	Effective porosity in net pay	$\emptyset_e$ = 20.8%
7.	Average water saturation in net pay	S_w = 48.2
8.	Gas gravity	ϱ_g = 0.611
9.	Critical temperature	T_c = 336.1°R
10.	Critical pressure	P_c = 650.9 psia
11.	Reservoir temperature	T_i = 527°R
12.	Initial reservoir pressure	P_i = 984.0
13.	Initial gas compressibility	Z_i = 0.88

TABLE II - LISTING OF TEST RESULTS

A. Volumetric Reserves:

Original gas in place = 353.466 McF/AcFt

B. Backpressure Analysis:

Absolute open flow = AOF = 7.22 MMcF/D
Back pressure slope = n = 0.844
Back pressure constant = C = .000064062 $\frac{\text{MMcF/D}}{\text{PSI}^2}$

C. Pressure Buildup Analysis:

Initial reservoir pressure	P_i = 984 psia
Flow Capacity	kh = 542.19 md ft

Permeability	$k = 33.89$ md
Skin	$S = 1.348$
Skin pressure drop	$\Delta P_s = 42.22$ psi
Productivity index (actual)	$J_a = 14.13 \frac{McF/d}{psi}$
Productivity index (ideal)	$J_i = 16.87 \frac{McF/d}{psi}$
Flow efficiency	$Ef = .837$
Gas mobility	$M = 2854.6$ md/cp
Effective wellbore radius	$r_w' = 1.104$ inch
Approximate radius of investigation	$r_{inv} = 462$ ft

D. Wellbore Pressure Gradient Survey:

BHP at 2037 ft	= 980.9
Fluid level	= 1767
WHP	= 793.0
Fluid gradient	= .515 psi/ft

DISCUSSION OF DATA, ANALYSIS TECHNIQUE, AND RESULTS

Original Gas in Place

The porosity, water saturation, and reservoir temperature used in the calculation of Original Gas in Place were derived from log analysis and are representative of the 16 feet of net pay selected between 2023 and 2040 feet. The initial reservoir pressure was derived from the buildup analysis, with both the initial and final buildup curves indicating 984.0 psia. The pressure readings were taken from the Sperry Sun Tool No. 311 at 2037 feet.

The calculated value of Original Gas in Place is 353.466 McF/Ac ft. This is 18.5% higher than the assumed value of 298.2 McF/Ac ft in use for the South Barrow field. The primary cause of this difference is the porosity of 20.8% as opposed to the 16.0% in use as an average field porosity.

Four Point Backpressure Analysis

The pressure-flow history obtained during the four point flow test was very smooth and provided excellent alignment of points in the plot of $P_c^2 - P_t^2$ vs Q. The indicated absolute open flow was 7.22 MMcF/d. The backpressure slope was 0.844.

Reservoir Parameter Analysis

Two types of reservoir parameter analysis were performed. The first drawdown of the four point flow was analyzed as was the final buildup. Table III compares the results of these two analyses.

The drawdown analysis technique was based on the semilog plot of Pwf vs log Tp and the pressure equation:

$$Pwf = P_i - \frac{28984\ q\ \mu g B g}{kh}\left[\log Tp + \log \frac{k}{\phi \mu g C_t r_w^2} - 3.2275 + 0.86859\ S\right]$$

The final buildup was analyzed using a multiple flow rate technique with the plot of P_{ws} vs $\sum_{j=1}^{n} q_j/q_n \log\left(\frac{Tn - T_{j-1} + \Delta T}{Tn - T_j + \Delta T}\right)$

and the equation of the straight line being

$$P_{ws} = P_j - \frac{28984\ q\ \mu g\ Bg}{kh} \sum_{j=1}^{n} q_j/q_n \log\left(\frac{T_n - T_{j-1} + \Delta T}{T_n - T_j + \Delta T}\right)$$

This analysis was chosen as the most representative of the reservoir as the flow and buildup times were the longest and the shut in pressure at the start of the flow period was nearest to the projected initial reservoir pressures. Table III shows that the values of kh are in close agreement. The kh in use in the South Barrow field is 154.5 md ft. The calculated kh for Wells No. 14 and No. 17 were 346.28 md ft and 493.80 md ft respectively. The values of Skin, ΔP_s and r_w' show considerable divergence. This can be explained, however, by the rate dependent nature of these parameters. The most significant fact about the Skin and Flow Efficiency parameters is that they show a considerably larger amount of formation damage than was indicated by the tests of Well No. 17 and Well No. 14.

TABLE III - COMPARISON OF TEST ANALYSES

Derived Parameter	Drawdown Value	Buildup Value
Flow Capacity	kh = 567.90 md/ft	kh = 542.19 md/ft
Permeability	k = 35.49 md	k = 33.89 md
Skin	S = .786	S = 1.348
Skin Pressure Drop	ΔP_s = 6.77 psi	ΔP_s = 42.22 psi
Actual Productivity Index	J_a = 19.57	J_a = 14.13
Ideal Productivity Index	J_i = 22.06	J_i = 16.87
Flow Efficiency	E_f = 88.71	E_f = 83.7
Gas Mobility	M = 2936.9 $\frac{md}{cp}$	M = 2854.6 $\frac{md}{cp}$
Effective Wellbore Radius	r_w' = 1.936 inch	r_w' = 1.104 inch
Radius of Investigation	r_{inv} = 222 ft	r_{inv} = 462.6 ft

Pressure Gradient Survey

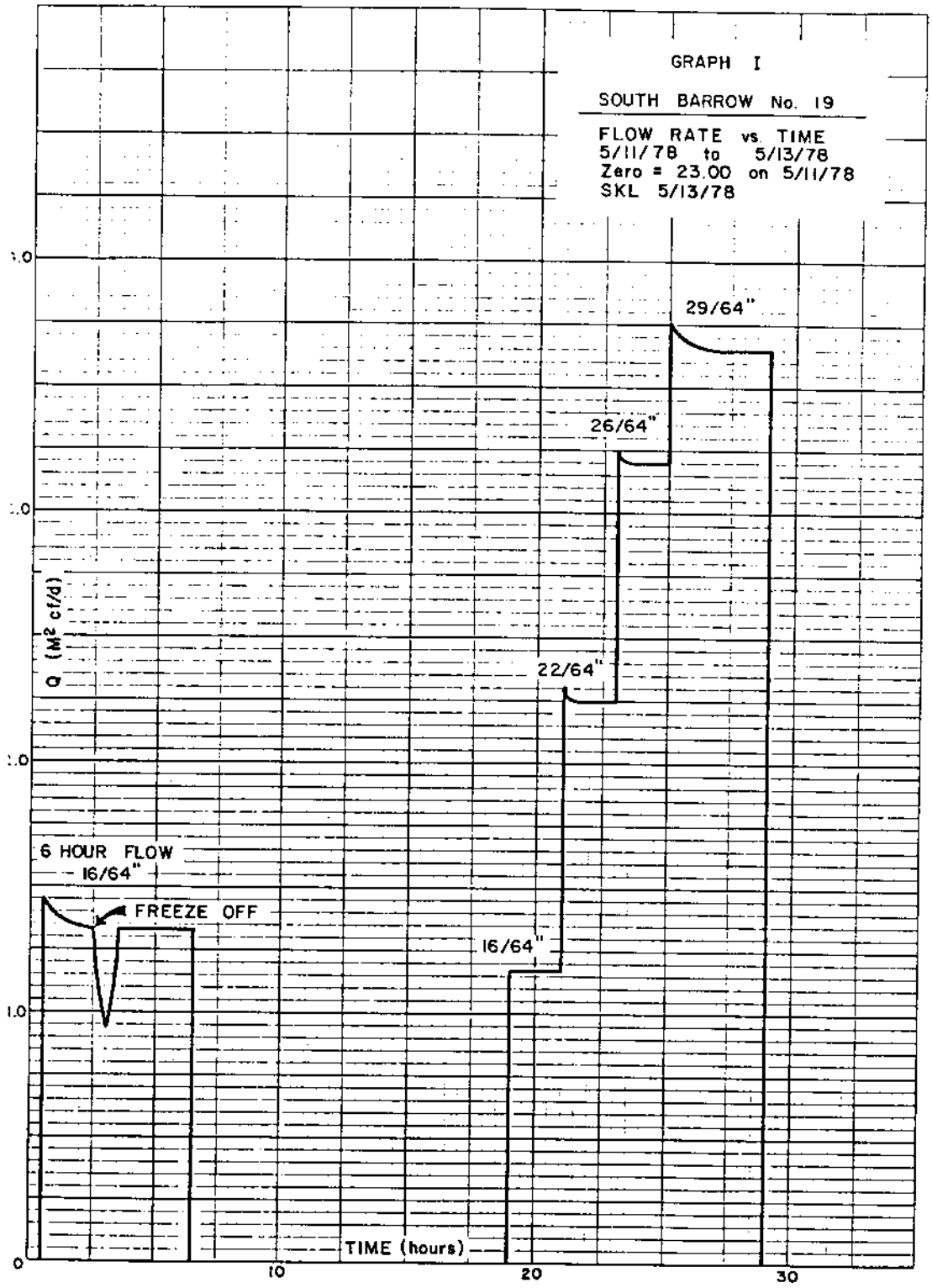
The pressure gradient survey was run with stops at 25, 50, 100, 500, 1000, and 1500 feet of bottom. The survey results are presented in Table II.

CONCLUSIONS AND RECOMMENDATIONS

The production testing of South Barrow No. 19 was exceptionally smooth operationally and yielded excellent pressure and flow data. Minor problems were experienced with the test tree and one flow line freeze off was successfully countered with alcohol injection.

The somewhat higher (as compared to South Barrow Wells No. 14 and 17) skin damage may be due to the 232 psi overbalance being carried when the well was perforated. It would appear that 100 psi overbalance might be a better operation parameter from a reservoir viewpoint. Also of interest is the total absence of produced water during the flow period. This is probably due to the structurally high position of the well. As compared to the water production experienced in well No. 17, the gas nature of Well No. 19 confirms the importance of staying high on the structure in future wells and exercising caution in selecting the perforation interval in any wells which may be drilled lower on the structure.

DATA AND EXAMPLE CALCULATIONS


GRAPH I
SOUTH BARROW No. 19
FLOW RATE vs. TIME
5/11/78 to 5/13/78
Zero = 23.00 on 5/11/78
SKL 5/13/78
29/64"
26/64"
22/64"
16/64"
6 HOUR FLOW
16/64"
FREEZE OFF
Q (M² cf/d)
TIME (hours)
0
10
20
30

EXAMPLE CALCULATION I

Volumetric Reserve Calculation

Original Gas in Place - McF/AcFt

43560 Ft^2/Ac

$\emptyset_e$ = 20.8%

Sw = 48.2%

P_i = 984.0 psia

T_i = 67°F

Z_i = .880

T_{sc} = 520°R

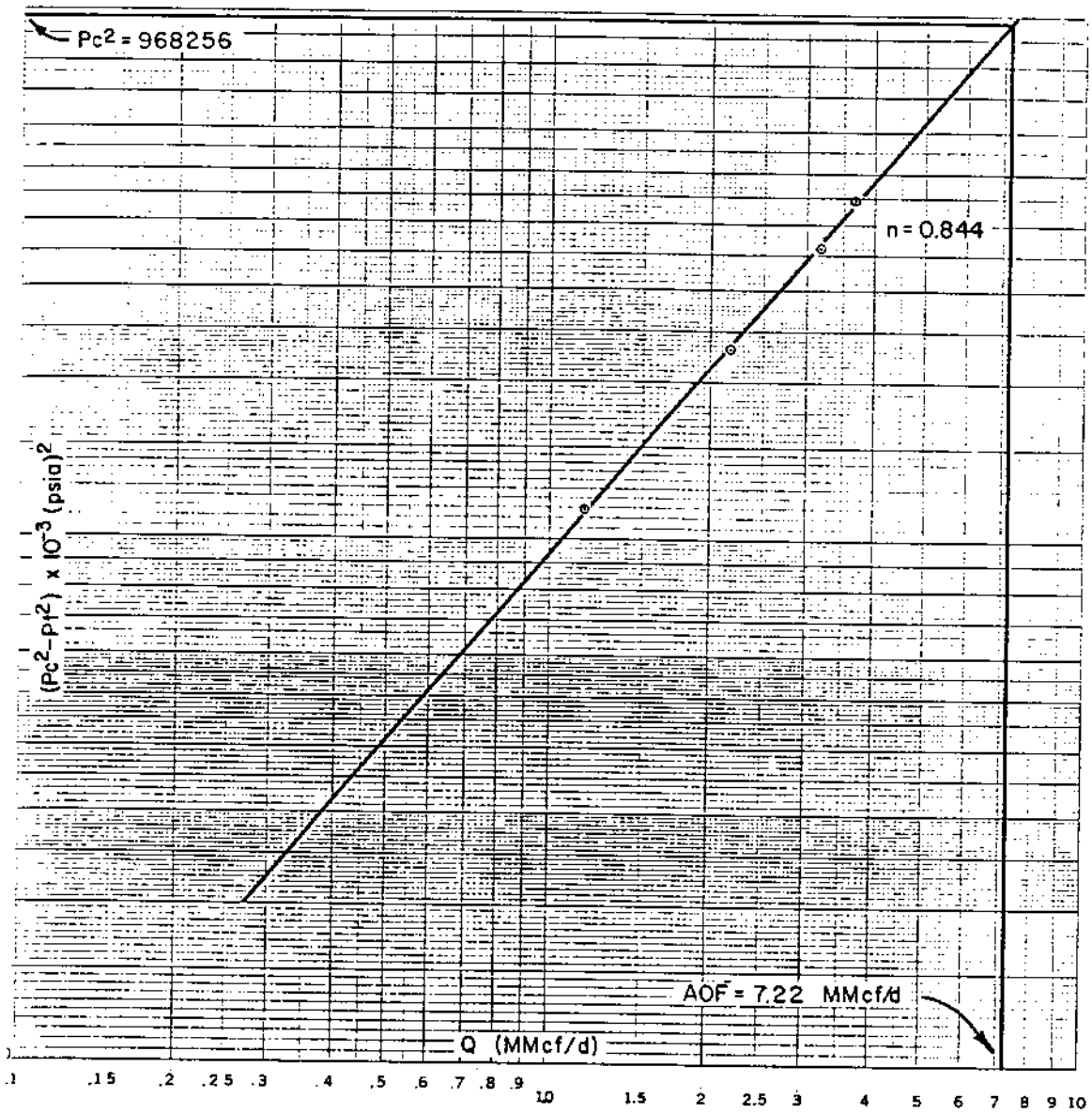
P_{sc} = 14.65 psia

$$OGIP = A \emptyset Sg \frac{P_i}{P_{sc}} \frac{T_{sc}}{T_i} \frac{1}{Z_i}$$

$$= 43560 \times .208 \times .518 \times \frac{984}{14.65} \times \frac{520}{527} \times \frac{1}{.87}$$

= 353.466 McF/Ac Ft

ATTACHMENT 2



GRAPH II

SOUTH BARROW No. 19

Q vs Pc^2-Pt^2

Sperry Sun Tool No. 311

at 2037'

SKL 5/13/78

EXAMPLE CALCULATION II

Four Point Flow Test - 5/12/78

Initial Reservoir Pressure = 984 psia

Rate	Choke	Pressure	Flow Rate	ΔP^2
1	16/64	924.2 psia	1.170 M^2cF/d	114077
2	22/64	858.5 psia	2.188 M^2cF/d	231233
3	26/64	779.4 psia	3.191 M^2cF/d	360826
4	29/64	724.5 psia	3.687 M^2cF/d	445165

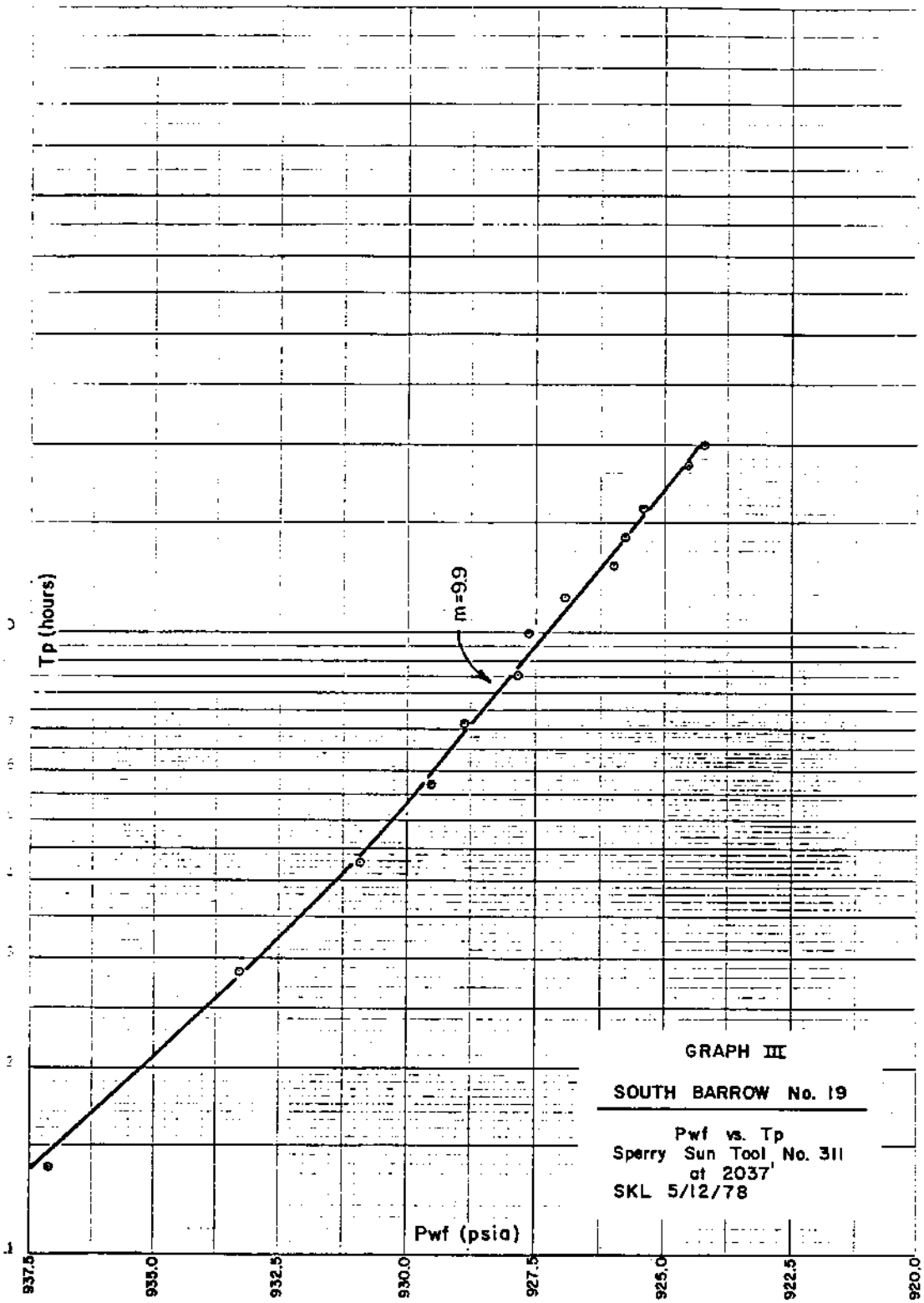
AOF = 7.220 M^2cF/d

n = .844

c = .000064062 $\frac{M^2cF/d}{ps^2}$

ATTACHMENT 4

30


Tp (hours)
m=9.9
Pwf (psia)
937.5
935.0
932.5
930.0
927.5
925.0
922.5
920.0
GRAPH III
SOUTH BARROW No. 19
Pwf vs. Tp
Sperry Sun Tool No. 311
at 2037'
SKL 5/12/78

EXAMPLE CALCULATION III

First Drawdown - Sperry Sun Tool 311 at 2037'

I. $B_g = Z \frac{T}{T_{sc}} \frac{P_{sc}}{\frac{Pi-Pwf}{2}}$ $T_c = 336.1^oR$ $P_c = 650.9$ $T_R = 1.568$ $P_R = \frac{954.1}{650.9} = 1.466$

$z = .882$

$B_g = .882 \frac{527}{520} \frac{14.65}{954.1} = .01372$

II. $\mu g = \mu g/\mu i = 0.0106 \text{ X } 1.14 = .012084$

III. $C_t = SgCg + SwCw + CF = (.518 \text{ X } .00115225) + (.482 \text{ X } 3.3 \text{ X } 10^{-6}) + (3.3 \text{ X } 10^{-6}) = C_t = .0006017561$

IV. $kh = \frac{28984 \, q \, \mu g B g}{m}$ $= 567.9$ mdft $k = 35.49$ md

$q = 1170$ McF/d
$m = 9.9$
$h = 16$
$P1hr = 927.3$ psia
$Pi = 984$ psia
$rw = 4.25"$
$\emptyset = .208$

V. $S = 1.1513 \left(\left(\frac{Pi - P1hr}{m} \right) - \log \left(\frac{k}{\emptyset \mu C t r_w^2} \right) + 3.2275 \right)$

$S = .786117$

VI. $\Delta P_s = m \text{ X } .87(S) = 9.9 \text{ X } .87 \text{ } (.786117) = 6.77$ psi

VII. Productivity Index = J

$J_a = \frac{q}{P_i - P_{wf}} = \frac{1170}{984.0 - 924.2} = 19.57 \frac{\text{McF/d}}{\text{psi}}$

$J_i = \frac{q}{(P_i - P_{wf}) - \Delta P_s} = \frac{1170}{984 - 924.2 - 6.77} = 22.06 \frac{\text{McF/d}}{\text{psi}}$

Flow Efficiency $= \frac{J_a}{J_i} = \frac{19.57}{22.06} = .8871$

ATTACHMENT 6

VIII. Average Gas Mobility = M

$$M = \frac{k_g}{\mu_g} = \frac{35.49}{.012084} = \frac{2936.94 \text{ md/CP}}{}$$

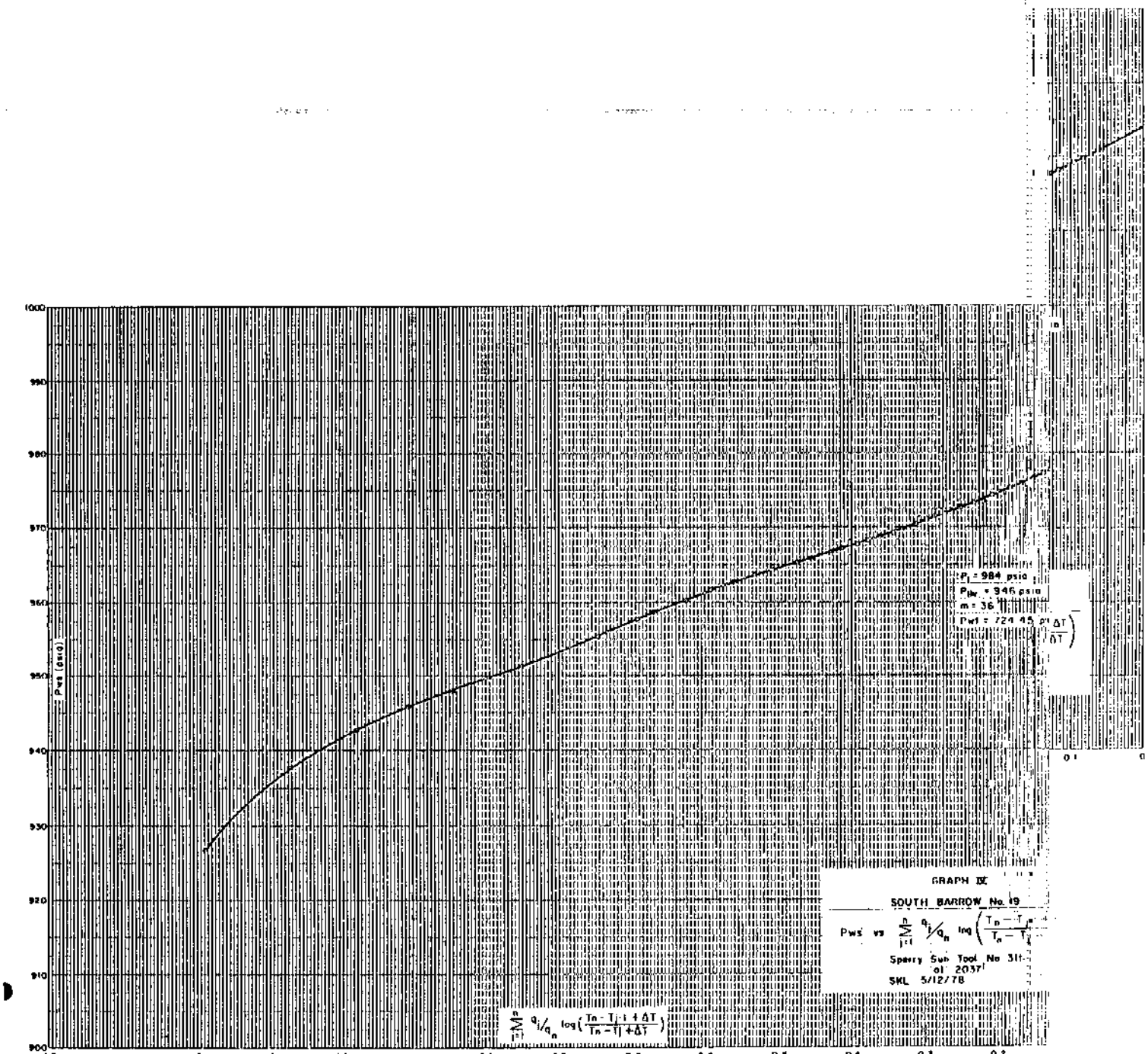
IX. Effective Wellbore Radius = r_w'

$$r_w' = r^w e^{-s} = 1.936 \text{ inches}$$

X. Approximate Radius of Investigation = r_{inv}

$$r_{inv} = \sqrt{\frac{0.00105\ k\ T_p}{\phi\ \mu\ C_t}} = 222 \text{ ft}$$

ATTACHMENT 6



1000
990
980
970
960
950
940
930
920
910
900
Pws (psia)
P_i = 984 psia
P_{lw} = 946 psia
m = 36
Pwf = 724.45 psi
$\left(\frac{\Delta T}{\Delta T}\right)$
0.1
0
GRAPH IV
SOUTH BARROW No. 19
Pws vs $\sum_{j=1}^{n} q_j/q_n \log\left(\frac{T_n - T_j}{T_n - T_j}\right)$
Sperry Sun Tool No 31t-
ol 2037
SKL 5/12/78
$\sum_{j=1}^{n} q_j/q_n \log\left(\frac{T_n - T_{j-1} + \Delta T}{T_n - T_j + \Delta T}\right)$

EXAMPLE CALCULATION IV

Final Buildup - Sperry Sun Tool 311 at 2037'

I. $B_g = Z \frac{T}{T_{sc}} \frac{P_{sc}}{\frac{Pi-Pwf}{2}}$ $T_c = 336.1^\circ R$ $P_c = 650.9$ $T_R = 1.568$ $P_R = \frac{854.225}{650.9} = 1.312$

$Z = .890$

$B_g = .890 \frac{527}{520} \frac{14.65}{854.225} = .015469$

II. $\mu g = \mu i \times \mu g/\mu i = .0106 \times 1.12 = .011872$

III. $C_t = SgCg + SwCw + CF = (.518 \times .00129052) + (.482 \times 3.3 \times 10^{-6}) + (3.3 \times 10^{-6}) = C_t = .0005606721$

IV. $kh = \frac{28984 \ q \ \mu g B g}{m}$

$q = 3667$ McF/d
$m = 36$
$h = 16$
$Plhr = 946$
$Pwf = 724.45$
$rw = 4.25"$
$\emptyset = .208$

V. $S = 1.1513 \left(\left(\frac{Plhr - Pwf}{m} \right) - \log \left(\frac{k}{\emptyset \mu C t r_w^2} \right) + 3.2275 \right)$

$S = 1.348$

VI. $\Delta P_s = m \times .87(S) = 36 \times .87 \ (1.348)$
$= 42.22$ psi

VII. Productivity Index = J

$J_a = \frac{q}{P_i - P_{wf}} = \frac{3667}{984 - 724.45} = 14.128 \frac{McF/d}{psi}$

$J_i = \frac{q}{P_i - P_{wf} - \Delta P_s} = \frac{3667}{(984 - 724.45) - 42.22} = 16.873 \frac{McF/d}{psi}$

Flow Efficiency $= \frac{J_a}{J_i} = \frac{14.128}{16.873} = 0.837$

ATTACHMENT 8

VIII. Average Gas Mobility = M

$$M = \frac{kg}{\mu g} = \frac{33.89}{.011872} = 2854.6 \text{ md/CP}$$

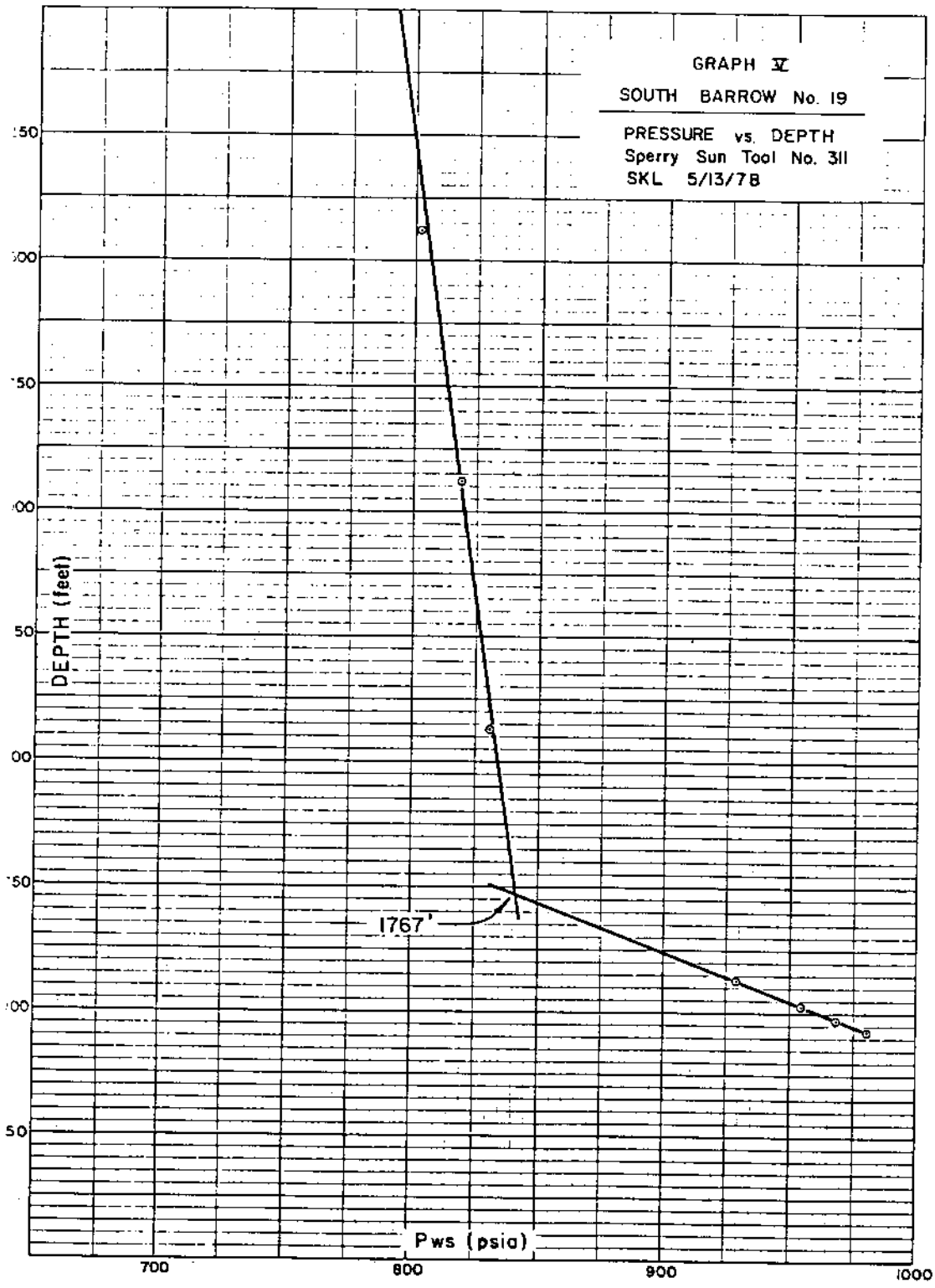
IX. Effective Wellbore Radius = r_w'

$$r_w' = r^W e^{-S} = 1.104 \text{ inches}$$

X. Approximate Radius of Investigation = r_{inv}

$$r_{inv} = \sqrt{\frac{0.00105\ k\ Tp}{\emptyset\ \mu\ C_t}} = 463 \text{ ft}$$

ATTACHMENT 8
Page 2


GRAPH IV
SOUTH BARROW No. 19
PRESSURE vs. DEPTH
Sperry Sun Tool No. 311
SKL 5/13/78
DEPTH (feet)
1767'
Pws (psia)
700
800
900
1000

EXAMPLE CALCULATION V

Pressure Gradient Test - 5/13/78

D	L	P	ΔP	Gradient
2037	0	980.9	0	-
2012	25	968.1	12.8	.512 psi/ft
1987	25	954.7	13.4	.536 psi/ft
1937	50	929.4	25.3	.506 psi/ft
1437	500	831.0	98.4	.197 psi/ft
937	500	819.7	11.3	.023 psi/ft
437	500	802.2	17.5	.035 psi/ft
0	437	793.0*	9.2	.021 psi/ft*

*Extrapolated from plot of P vs D

ATTACHMENT 10