COLUMBIA ET AL KOTANEELEE YT H-38- B-38

FINAL REPORT

Prepared for:

Columbia Gas Development of Canada Ltd.

November, 1977

Prepared by:

D&S PETROLEUM FIELD SERVICES LTD.

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2336

COLUMBIA ET AL KOTANEELEE YT H38

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SECTION I

SUMMARY OF WELL DATA

a.	Well Name and Number:	Columbia et al Kotaneelee YT H38 ✓
b.	Permittees:	Canada Southern Pan American Oil Company Dome Petroleums ✓
c.	Name of Operator:	Columbia Gas Development of Canada 1420 Standard Life Building 637 Fifth Ave. S.W. Calgary, Alberta ✓
d.	Location:	Yukon Territory Unit: H Section: 38 Latitude: 60° 07' ~~13.5~~" N 16" Longitude: 124° 06' ~~31.8~~" W.03" Universal Well Location Reference: Latitude: 60.12041°N 60.12111° Longitude: 124.10883°W 124.10083°
e.	Co-ordinates:	Shot Point 105, Line DHP-004
f.	Permit Number:	1007
g.	Drilling Contractor:	Nabors Drilling Ltd. Rotary Rig #9 ✓
h.	Drilling Authority:	No. 878 ✓
i.	Classification:	Development Well ✓
j.	Elevations:	Ground: 2225 feet R.K.B.: 2250 feet ✓
k.	Spudded	31 March ~~April 6,~~ 1977
l.	Completed Drilling:	October 14, 1977 ✓
m.	Total Depth:	12,789 feet ✓
n.	Well Status:	Gas Well ✓
o.	Rig Release Date:	0800 29 ~~12:~~00 noon, October ~~21~~, 1977
p.	Hole Size	26" - 0' to 771' 17½" - 771' to 3020' 12¼" - 3020' to 10,850' 8½" - 10,850' to 12,789'
q.	Casing:	20" O.D. set at 771' 13 3/8" O.D. set at 3020' 9 5/8" O.D. set at 10,850' 7" O.D. set at 12,789'

SECTION II

Geological Summary

NOTE: The following information was provided by Exploration Logging Canada Ltd., who provided the complete geological and mud logging service.

FORMATION TOPS FOR KOTANEELEE YT H-38.

AGE	FORMATION	DEPTH	SUB-SEA DEPTH
Cretaceous	Spirit River	Spud	
Triassic	Toad-Grayling	Above Logged Interval	
Permian	Fantasque	1318'	+ 932'
Mississipian	Mattson	1658'	+ 592'
	Flett	5605'	- 3355'
Mississipian-Devonian	Besa River	9870'	- 7620'
Mid-Devonian	Nahanni	11,635'	- 9385'

CORRELATION OF FORMATION TOPS FOR KOTANEELEE YT H-38 AND NORTH BEAVER RIVER YT 1-27 WITH STRUCTURAL DIFFERENCES

H-38			1-27		
DEPTH	SUB-SEA	FORMATION	DEPTH	SUB-SEA	STRUCTURAL DIFFERENCE (H38-127)
Spud		Spirit River	Spud		
Above Logged	Interval	Toad-Grayling	1180'	+ 266'	
1318'	+ 932'	Fantasque	2320'	- 874'	+ 1806'
1658'	+ 592'	Mattson	2895'	- 1349'	+ 2041'
5605'	- 3355'	Flett	6480'	- 5034'	+ 1679'
9870'	- 7620'	Besa River	9065'	- 7619'	- 1'
11635'	- 9385'	Nahanni	12160'	-10714'	+ 1329'

CORED INTERVALS

SIDEWALL CORES

No sidewall cores were taken.

CONVENTIONAL CORES

	INTERVAL	CUT	RECOVERED
CORE #1	8134 - 8169'	35'	35'
#2	11690' - 11750'	60'	60'
#3	12040' - 12064'	24'	24'
#4	12260' - 12320'	60'	60'
#5	12450' - 12510'	60'	60'
#6	12708' - 12755'	47'	47'
#7	12755' - 12789'	34'	34'

CORE DESCRIPTIONS

CORE #1

Interval: 8134' - 8169'

Cut 35' Recovered 35'

DEPTH FROM	TO	LITHOLOGY
8134 - 8136.9		SHALE, black, hard, fissile, blocky-conchoidal fracture, none-slightly calcareous. Average drill rate 4.35'/hour.
8136.9 - 8138.1		SHALE, as above, with increasing numbers of very thin, usually 1-3 millimeters marl layers, medium gray-light brown, hard, silty in part, occasionally showing small-scale slumping. Average drill rate 4.20'/hour.
8138.1 - 8138.3		SHALE, as above with several 1 millimeter-thick calcite veins, most at an angle to the bedding and fissility.
8138.3 - 8140.5		MARL, 50%, light brown-gray, hard, becoming silty in part and occasionally grading to a very fine calcerenite, occurs as discrete layers usually 1-2 millimeters thick, occasionally forming lenses up to 10 millimeters in thickness, alternating with SHALE, 50%, black, hard, fissile, noncalcareous, splintery-conchoidal fracture. Average drill rate 4.4'/hour.
8140.5 - 8141.7		SHALE, 95%, as above, with very thin marl stringers, 5%, as above. Average drill rate 3.6'/hour.
8141.7 - 8144.1		SHALE, as above, 95% with thin marl layers, as above. The noncalcareous bands are very fine, black, hard, fissile mudstone while the slightly-moderately calcareous bands are slightly coarser occasionally grading to siltstone, very fine, black, moderately hard-hard, fissile. There are occasional thin bands of calcilutite/calcerenite, light brown-gray, moderately-very calcareous. Average drill rate 5.33'/hour.
8144.1 - 8145.7		SHALE, 100%, black, hard, fissile, conchoidal

	fracture, predominantly slightly-moderately calcareous with several interbeds of noncalcareous shale. Some calcite veining mainly at the top of the section along and across the bedding. Average drill rate 4.9'/hour.
8145.7 - 8157.7	SHALE, 97%, as above, predominantly calcareous, very slightly coarser than the noncalcareous layers. Between 8147.7 and 8148 are two 18 millimeters layers of very fine calcerenite, light brown-gray, very calcareous showing small-scale cross-lamination structures and a very slight trace of disseminated pyrite with slightly more in the bottom of the two layers, but none in the intervening shale so it is probable that the pyrite is of clastic origin rather than being precipitated in situ. There is some calcite veining in the shale, showing fibrous or cross-hatched textures.
8157.7 - 8157.8	LIMESTONE, black, hard-very hard, blocky, microcrystalline, very tight, no visible porosity.
8157.8 - 8157.9	LIMESTONE, light brown-gray, hard, microcrystalline finely banded, slightly silty in part with a trace of disseminated pyrite.
8157.9 - 8159.0	SHALE, 83%, black, hard, subfissile, predominantly fissile, conchoidal fracture, moderately-very calcareous. At the bottom are two 20 millimeters LIMESTONE layers, light brown-gray, locally slightly silty with specks of disseminated pyrite.
8159.0 - 8162.5	SHALE, black, moderately hard-hard, subfissile-predominantly fissile, splintery-conchoidal fracture, moderately calcareous with several thin LIMESTONE layers, light brown-gray 5% or less of the section and very occasionally small calcite veins usually across the bedding with the main vein at the bottom showing sutured contacts with the shale. Average drill rate 6.77'/hour.
8162.5 - 8162.6	FOSSIL debris bed, predominantly comprising crinoid ossicles, occasionally with clasts of black shale, good trace of disseminated pyrite with some replacement of calcite in the crinoid plates by pyrite. No bedding is apparent so it was probably deposited rapidly by slumping.
8162.6 - 8163.5	SHALE, black, hard, fissile, splintery, noncalcareous

	grading through calcilutite to LIMESTONE, dark gray-brown to black. Average drill rate 7.5'/hour.
8163.5 - 8166.5	LIMESTONE, dark gray-brown to black, very hard microcrystalline, blocky, very tight, occasional crinoid fragments and disseminated pyrite. The top 100 millimeters grades from fine to coarse with increasing amounts of crinoid debris, grading rapidly through an uneven contact to a finer LIMESTONE, microcrystalline-cryptocrystalline, fairly uniform, very hard with good trace of calcite plates. Average drill rate 9.0'/hour.
8166.5 - 8167.7	LIMESTONE, as above with increasing amounts of fossil fragments, predominantly crinoid ossicles, very occasional brachiopod fragments, abundant calcite plates. The limestone grades from microcrystalline to very fossiliferous.
8167.7 - 8168.3	LIMESTONE, dark gray-black, hard to very hard microcrystalline-cryptocrystalline, blocky, no visible porosity, with approximately 65% by volume of fossil fragments and increasing amounts of brachiopod fragments, abundant crinoid fragments. Abundant pyrite both massive and disseminated, occasionally as well-formed cubes within calcite. Average drill rate 4.9'/hour.
8168.3 - 8169.0	SHALE, black, moderately hard, splintery-conchoidal fracture, fissile, moderately-very calcareous with slight calcite veining.

CORE #2

Interval: 11690' - 11750'

Cut 60' Recovered 100%

DEPTH FROM	TO	LITHOLOGY
11690	11702	DOLOMITE, medium-dark gray, micro-fine crystalline, general brecciated, angular-subrounded clasts of dolomitized lime wacke and mudstone surrounded by white crystalline dolomite, 10% fossil debris replaced by white crystalline dolomite, trace non-effective open vuggy porosity, impermeable, with poor effective vuggy porosity at 11698.9' and 11701'. Infill sequence: 1) White crystalline dolomite 2) Clean authigenic quartz as druse and needles up to 1" long 3) Sphaleritic infill of fractures 4) Introduction of hydrocarbon residue of black, conchoidal fracture, vitreous carbon, resembling anthracite Average drill rate 5.3'/hour.
11702	11705	DOLOMITE, medium-dark gray, very fine microcrystalline, lime wacke and mudstone, dolomitized brachiopods, brecciated and diagenetically altered as above, patchy poor vuggy porosity. Average drill rate 3.4'/hour.
11705	11717	DOLOMITE, medium-dark gray, very fine-medium crystalline, dolomitized lime wacke-and mudstone, diagenetically altered as above, poor non-effective vuggy porosity, galena at 11716'. Average drill rate 2.1'/hour.
11717	11731	DOLOMITE, medium-dark gray, very fine-medium crystalline, dolomitized wackestone, brachiopods and subspherical colonial fossils. Average drill rate 3.3'/hour.
11731	11733	DOLOMITE, dark gray, dolomitized lime mudstone, argillaceous with brachiopods. Average drill rate 2.0'/hour.
11733	11750	DOLOMITE, medium-dark gray, dolomitized lime wackestone, brecciated and healed in part with white crystalline dolomite, brachiopods, THAMNOPORA. Average drill rate 3.2'/hour.

CORE #3

Interval: 12040' - 12064'

Cut 24' Recovered 100%

DEPTH FROM	TO	LITHOLOGY
12040 - 12064		DOLOMITE, dark gray, irregular pods micro fine crystalline in bituminous microcrystalline dolomite matrix, 20-30% white medium-coarse crystalline dolomite as fossil replacement, vuggy lining, breccia matrix and fracture filling, patches of dark gray dolomite breccia in white dolomite matrix, trace brachiopods and ?THAMNOPORA, ?Stromatolitic algae at 12042' poor-fair vuggy and high-angle fracture porosity, trace black anthracite-like bitumen in vugs lined with white dolomite covered with druse of clear quartz, open high-angle fracture from 12045-7', 12048-53', 12057-64', core jamming at 12062'. Average drill rate 5.3'/hour.

CORE #4

Interval: 12260' - 12320'

Cut 60' Recovered 100%

DEPTH FROM TO	LITHOLOGY
12260 - 12265	DOLOMITE, breccia, angular clasts, dark gray, bituminous, microcrystalline, in 20% medium-coarse crystalline white dolomite cement, poor vuggy porosity, trace argillaceous stringers, dip*20°. Average drill rate 6.7'/hour.
12265 - 12271.5	DOLOMITE, dark gray, microcrystalline, bituminous, banded or varved, ¼" thick, interbedded, medium-dark gray, fine-very fine crystalline and white, micro coarse crystalline, interpreted as dolomitized interbedded lime mudstone and grain-supported porous limestone subsequently mobilized penetrating the lithologies described above, low-angle small scale cross-bedding, poor vuggy porosity, trace bitumen, white calcite in micro-fracture, brecciated in part, bituminous argillaceous partings, dip*20°, brachiopods at 12271'. Average drill rate 7.1'/hour.
12271.5 - 12282.5	DOLOMITE, medium-dark gray, micro-medium crystalline, slump and flame structures, breccia from 12275.5-6', argillaceous partings below 12280', 20% white coarse crystalline dolomite with trace bitumen in poor vuggy porosity, dip*20-30°. Average drill rate 10.8'/hour.
12282.5 - 12285	DOLOMITE, breccia, dark gray, angular clasts to 2" diameter in 30% white, coarse crystalline, poor vuggy porosity. Average drill rate 10.9'/hour.
12285 - 12292.5	DOLOMITE, dark gray, dense, micro-very fine crystalline, bituminous, argillaceous partings, 5% white crystalline dolomite as fracture filling and mobilized injected dolomitized grain-supported limestone, tight, brachiopod at base, dip*10°. Average drill rate 8.9'/hour.
12292.5 - 12299	DOLOMITE, medium gray, irregular pods of fine crystalline dolomite separated by stylolitic partings of argillaceous microcrystalline dolomite, fair-vuggy porosity, dolomitized lime-wackestone with brachiopod. Average drill rate 12.0'/hour.

CORE #4 CONT'D

12299 - 12300.5	DOLOMITE, medium gray, fine crystalline with 30% white coarse crystalline dolomite, fair vuggy porosity, dolomitized lime wackestone, brachiopods. Average drill rate 15.0'/hour.
12300.5 - 12308	DOLOMITE, medium gray, medium crystalline, 10% white coarse crystalline dolomite, stringers of dolomite breccia, argillaceous stylolitic partings in lower part, trace poor vuggy porosity. Average drill rate 9.8'/hour.
12308 - 12314.5	DOLOMITE, medium gray, fine-medium crystalline, stylolitic partings of black shale, partly mobilized, dip*20-30°, partly brecciated and trace vuggy porosity in lower 2'. Average drill rate 10.3'/hour.
12314.5 - 12320	DOLOMITE, dark-medium gray, fine-microcrystalline, dolomitized lime wackestone with undetermined fossil, streaky fair leached fossil porosity. Average drill rate 12.4'/hour.

*Dip - angle between bedding features and plane normal to axis of core. Hole deviation 6° from vertical.

CORE #5

Interval: 12450' - 12510'

Cut 60" Recovered 100%

DEPTH FROM	TO	LITHOLOGY
12450 - 12470		DOLOMITE, medium-dark gray, slightly argillaceous and bituminous, in part brecciated with white coarse crystalline dolomite matrix, micro-fine crystalline clasts, 10-30% white dolomite, poor vuggy porosity. Average drill rate 10.3'/hour.
12470 - 12484		DOLOMITE, dark gray, very fine-fine crystalline, dolomitized lime wackestone, finely comminuted fossil debris, depositional dips approximately 30°, in part brecciated, pre-lithification slump features, trace high-angle open micro-fractures, trace stylolitized argillaceous partings, trace non-effective vuggy porosity. Average drill rate 7.5'/hour.
12484 - 12510		DOLOMITE, medium-dark gray (70%), fine-microcrystalline, dolomitized lime mudstone and wackestone, white (20-30%) crystalline dolomite as breccia cement and fracture filling, poor vuggy porosity, bitumen partly filling vugs, high-angle micro-fractures, in part massive with 20-30° depositional dip, brecciated in part. Average drill rate 6.0'/hour.

CORE #6

Interval: 12708' - 12755'

Cut 47' Recovered 100%

DEPTH FROM	TO	LITHOLOGY
12708	- 12719	DOLOMITE, medium-dark gray, micro-very fine crystalline, slightly bituminous and argillaceous, generally massive and dense, dolomitized lime mudstone, low-angle depositional dip, below 12715' with 10% white coarse crystalline dolomite stringers and fracture-fill, vertical micro-fractures at 12713', generally tight with open quartz druse-lined vugs at 12718.5', trace stylolitic truncation of white dolomite-filled fractures, trace inter-crystalline bitumen. Average drill rate 6.3'/hour.
12719	- 12720	DOLOMITE, medium-dark gray, micro-fine crystalline dolomitized lime mudstone, and wackestone, sedimentary breccia cut and intruded by 30% white coarsely crystalline dolomite-filled veins, stylolitic, tight. Average drill rate 7.5'/hour.
12720	- 12742.5	DOLOMITE, medium-dark gray, micro-fine crystalline, dolomitized lime mudstone, lime wackestone and mudstone wackestone breccia in 1-3' intervals. Early sedimentary breccia cut by white dolomite-filled fractures causing second-generation brecciation, second generation white dolomite modified by stylolite development, trace vertical micro-fractures, open vugs at 12730-32', general low-angle depositional dips average 20° at 12732', open vugs lined with clear quartz druse, generally tight with vuggy porosity from 12730-32', vertical fracture porosity 12732-35', 12741.42.5'. Average drill rate 6.0'/hour.
12742.5	- 12748.5	DOLOMITE, medium gray, fine crystalline, dolomitized lime mudstone-wackestone in part brecciated and resulting in "zebra-striped" dolomite, 10% infill with white coarse crystalline dolomite, in part stylolized, low-angle depositional dips. Average drill rate 3.8'/hour.
12748.5	- 12753.5	DOLOMITE, dark gray, fine-micro crystalline, dolo-

CORE #6 CONT'D

	mitized lime mudstone and wackestone, pods of wackestone in mudstone matrix, 30% white coarse crystalline dolomite stringers and fracture-fill sub parallel to and at high-angle to bedding, depositional dips low-angle to 20°, trace open vuggy porosity probably not interconnected. Average drill rate 4.1'/hour.
12753.5 - 12755	DOLOMITE, medium-dark gray, micro-very fine crystalline, dolomitized lime mudstone, low-angle depositional dip, trace high-angle microfractures, trace pyrite. Average drill rate 2.9'/hour.

CORE #7

Interval: 12755' - 12789'

Cut 34' Recovered 100%

DEPTH FROM	TO	LITHOLOGY
12755	12765.5	DOLOMITE, dark gray, microcrystalline, above 12762' massive, below 12762' faintly varved by alternation of micro-very fine crystalline dolomite, dolomitized bituminous lime mudstone above alternations of dolomitized lime mudstone and wackestone, low-angle depositional dip, 5% white coarse crystalline dolomite sub-parallel to bedding and along fractures, vertical and high-angle open microfractures, trace open isolated vugs at 12758.5' and 12762.5' not interconnected.
12765.5	12767	DOLOMITE, as above, gradational between under and over lying units, trace vuggy porosity.
12767	12773	DOLOMITE, medium gray, zebra-striped dolomite, dolomitized lime wackestone-grainstone, 30% white coarse crystalline dolomite stringers sub-parallel to bedding, poor vuggy and fracture porosity lined with dolomite druse, low-angle dip, high-angle fracture at 12768'
12773	12776	DOLOMITE, dark gray, micro-very fine crystalline, bituminous dolomitized lime mudstone and wackestone, 10% fracture-filling white dolomite, open high-angle fractures.
12776	12780.5	DOLOMITE, dark gray as above, but with 20% white coarse crystalline dolomite, fair vuggy and high-angle fracture porosity lined with white dolomite druse.
12780.5	12782.5	DOLOMITE, breccia, dark gray, dolomitized lime mudstone-wackestone as above in 40% white coarse crystalline dolomite matrix, slightly open vuggy and high-angle fracture porosity lined with dolomite druse, vuggy at 12781' lined with quartz druse.
12782.5	12789	DOLOMITE, dark gray, micro-very fine crystalline, dolomitized lime mudstone and wackestone, 10-20% white coarse crystalline dolomite stringers and patches, lower 2' include zebra-striped dolomite, slightly vuggy and high-angle fracture porosity.

CALCIMETRY RESULTS

CORE #2

Interval: 11690' - 11750'

DEPTH	LIMESTONE %	DOLOMITE %
11690	--	60
11695	--	70
11700	2	80
11705	--	76
11710	--	52
11715	--	78
11720	--	90
11725	--	98
11730	--	70
11735	--	95
11740	--	98
11745	--	100
11750	--	89

CORE #3

Interval: 12040' - 12064

DEPTH	DOLOMITE %
12040	82
12042	81
12044	96
12046	98
12048	81
12050	82
12052	84
12054	90
12056	99
12058	99
12060	100
12062	98

CORE #4

Interval: 12260' - 12320'

DEPTH	DOLOMITE %
12260	99
12265	100
12270	100
12275	99
12280	95
12285	94
12290	50
12295	81
12300	85
12305	93
12310	92
12315	99
12320	100

CORE #5

Interval: 12450' - 12510'

DEPTH	DOLOMITE %
12455	100
12460	99
12465	100
12470	100
12475	98
12480	100
12485	90
12490	100
12495	100
12500	98
12505	100
12510	100

CORE #6

Interval: 12708' - 12755'

DEPTH	DOLOMITE %
12710	96
12715	96
12720	96
12725	98
12730	99
12735	97
12740	99
12745	99
12750	100
12755	99

SAMPLE DESCRIPTIONS

0 - 1000	No samples.
1000 - 1030	Shale, 90% -100%, light-medium gray, fissile, interbedded with siltstone, 10%-trace, calcareous grading to very fine sandstone.
1030 - 1060	Shale, 90%-100%, as above becoming more brown, interbedded with 10%-trace siltstone.
1060 - 1080	Shale, 95%, medium brown-brick red-brown with 5% siltstone and sandstone.
1080 - 1105	Shale, 100%, light gray occasional calcite fragments probably from fracture filling.
1105 - 1116	Dolomite,50% dark gray, hard, very silty, pyritic limestone, 30%, gray to gray-white, hard, fractures filled with calcite. Trace oil with light greenish fluorescence and cut. Shale, 20%, as above with trace of coal.
1116 - 1130	Limestone, 90% and dolomite 10%, as above. Poor oil show. Shale, trace, as above.
1130 - 1150	Limestone, 70%, gray, hard, splintery. Dolomoite, 10%, dark gray, hard, silty. Siltstone, 10%. Sandstone,10% white, calcareous to dolomitic. Slight trace oil show, as above.
1150 - 1170	Shale, 90%-100%, dark to medium gray, very calcareous, hard, calcite veining and fragments. Abundant pyrite. Limestone, trace to 10%.
1170 - 1194	Siltstone, 40%, dark gray grading to shale and dolomite with finely disseminated pyrite. Limestone, 30%, gray to gray-white, hard, angular, blocky to splintery, microcrystalline. Shale 25%, as above. Dolomite 5%, as above. Slight trace oil show in limestone from fractures. Yellow-gold fluorescence. From 1190-1194' becoming 80%-90% limestone, as above.
1194 - 1220	Limestone, 40%-60%, white-gray, micro to medium cystalline, hard, splintery to blocky, calcite fractures containing some dead oil. Siltstone, 20%-30%, grading to 20% shale as above.
1220 - 1238	Limestone, 90%, white-gray, occasionally tan, as above. Trace dolomite green-yellow, sucrosic, hard, fine

	crystalline. Siltstone, 10% dark-gray, hard, blocky, calcareous.
1238 - 1260	Limestone, 85%, white-gray occasionally tan, microcrystalline, hard-very hard, occasionally silty, splintery. Silty sandstone, 15% dark gray, blocky, hard, occasionally pyritic. Trace oil show in limestone.
1260 - 1290	Limestone, 80% as above. Siltstone, 10%, sandy as above. Sandstone, 10%, light gray, fine-very fine, calcareous moderately hard to hard, poor porosity.
1290 - 1310	Siltstone, 75%, dark gray, hard, blocky, moderately calcareous, becoming sandy with abundant pyrite and specks of glauconite. Limestone, 25%, as above. Sandstone, trace, as above.
1310 - 1330	Dolomite, 40%, gray to gray-white, hard, very sandy, occasional calcite-filled fractures, tight poor porosity. Trace oil stain with light yellow crush-cut fluorescence. Siltstone, 30%, as above. Limestone, 20%, as above. Sandstone, 10%, as above with specks of pyrite and glauconite.
1330 - 1250	Siltstone, 40%, dark gray hard, siliceous to dolomitic. Dolomite, 30%, gray, hard, poor porosity, occasional calcite veining. Limestone, gray to gray-white, hard, microcrystalline, silty. Chert, 10% dark brown-dark gray, occasionally light gray, very hard, cryptocrystalline, splintery, occasional conchoidal fracture, silty in part, trace of glauconite and pyrite.
1350 - 1360	Siltstone, 50%, as above becoming more cherty. Chert 50%, as above.
1360 - 1390	Chert, 80%-100%, as above. Siltstone, 0-20%, very cherty as above.
1390 - 1460	Chert, 100%, light brown to light gray, occasionally white, very hard, mottled in part, very silty to very sandy, brittle, splintery, abundant pyrite and glauconite specks, trace pyrobitumen.
1460 - 1500	Chert 100%, as above with trace siltstone, dark gray, blocky, hard, siliceous to occasionally dolomitic.
1500 - 1550	Chert, 50%-90%, as above, becoming very silty and occasionally sandy especially in the lower 30'. Siltstone 10%-50%, as above, slightly dolomitic

	occasionally siliceous, grading to shale.
1550 - 1570	Siltstone, 40%, dark gray, hard, subfissile-blocky, siliceous, micromicaceous, pyritic. Shale, 30%, dark gray, hard, subfissile, silty, occasionally fine sandy, abundant pyrite. Chert, 30%, gray, very hard, blocky, very silty in part, occasionally translucent.
1570 - 1600	Shale, 50%, as above becoming more fissile, silty, siliceous, hard, pyritic. Siltstone, 30%, as above. Chert, 20%, as above.
1600 - 1620	Shale, 85%, dark brown-gray, hard, subfissile to fissile, very silty, siliceous to slightly dolomitic grading in part to siltstone. Chert, 15%, as above.
1620 - 1640	Shale, 65%, as above, soft in part, micromicaceous. Siltstone, 25%, dark gray-blocky, hard, siliceous-dolomitic, occasionally calcareous, very cherty in part with fine disseminated and veined pyrite and minor quartz and calcite. Chert, 10%, as above with quartz, calcite and black mineral veining.
1640 - 1650	Shale, 90%, as above, with increasing mica content. Siltstone, 10%, as above.
1650 - 1660	Shale, 70%, dark brown-gray, hard, subfissile to fissile, micromicaceous, very silty, siliceous to dolomitic, soft in part, light gray. Chert, 20%, gray, blocky, very hard, occasionally translucent, cryptocrystalline, very silty in part. Siltstone, 10%, dark gray, hard, blocky, very calcareous, very pyritic, cherty in part with associated mineral veining.
1660 - 1670	Shale, 40%, as above becoming calcareous to very calcareous with calcite veins and vein-filling. Siltstone, 40%, as above, with associated calcite and glauconite. Chert, 10%, as above. Limestone, 10%, white to light gray, hard, cherty in part with abundant calcite fragments (possible fracture-fillings) and abundant pyrite.
1670 - 1680	Siltstone, 15%, as above. Shale, 20%, as above. Limestone, 10%, as above. Sandstone, 20%, light gray, moderately hard, fine-grained, silty, subangular.
1680 - 1730	Sandstone, 80%, light gray-white, occasionally tan, very fine to fine-grained, friable to moderately hard, occasionally hard, calcareous, occasionally argillaceous, subangular, poor porosity, well sorted. Even to patchy

	oil-stain with faint straw cut. Light yellow, slow streaming with milky cut fluorescence. Shale, 10%, dark gray-brown, hard, occasionally soft, fissile to subfissile, calcareous, pyritic, grading to siltstone as above. Limestone, 10%, white, hard, occasionally soft, sandy, cherty and silty in part, tight to poor porosity, with abundant calcite fragments and trace oil show as above. At 1720' limestone, 20%, predominantly calcite probably fracture-filling and with occasional coarse quartz, dead oil stain with slow streaming cut, slight to good trace of oil show with some live oil, but mainly dead oil.
1730 - 1800	Sandstone, 90%-100% as above, very fine, in part grading to siltstone, siliceous in part, quartzose in part, with weak calcareous cement, poor to occasionally fair porosity, well sorted, subrounded to subangular. Limestone, 0-5%, predominantly soft, occasionally hard with calcite fragments. Siltstone, 0-5%, argillaceous, occasionally hard, occasionally siliceous, predominantly calcareous, sandy, grading to sandstone as above.
1800 - 1890	Sandstone, 100%, light to medium gray, fine to very fine-grained, silty, calcareous, slightly dolomitic, poor porosity.
1890 - 1900	Sandstone, 90%, as above. Dolomite, 10%, dark gray, hard, microcrystalline, silty, tight.
1900 - 1920	Sandstone, 60%, as above. Limestone, 40%, dark gray to black, hard, microcrystalline, massive, slightly shaly and silty, with calcite fracture-fillings.
1920 - 1940	Sandstone, 40%, as above. Siltstone, 40%, dark brown to gray, hard, calcareous, chalky, slightly dolomitic. Shale, 20%, dark gray to black, hard, very silty, fissile, noncalcareous.
1940 - 1970	Sandstone, 100%, light gray, very fine-grained, moderately hard, well sorted, calcareous, some yellowish sample fluorescence and trace pale blue-white cut fluorescence.
1970 - 1980	Sandstone, 70%, as above. Shale, 30%, dark gray, firm, fissile, noncalcareous, silty.
1980 - 1990	Sandstone, 40% as above. Siltstone, 60%, dark gray, shaly, subfissile, pale yellow sample fluorescence, pale yellow-white streaming cut fluorescence.

1990 - 2020	Sandstone, 100%, light to medium gray, moderately hard, very calcareous, fine to medium-grained, occasionally very fine-grained, angular, poorly sorted, spotty dead oil stain with specks of pyrobitumen, dull yellow sample fluorescence, slow weeping pale yellow-white cut fluorescence.
2020 - 2040	Sandstone, 30%, as above. Siltstone, 70%, dark gray, hard, shaly, subfissile, calcareous.
2040 - 2050	Sandstone, 40%, as above. Shale, 40%, dark gray to black, fissile, very bituminous, trace coal, non-calcareous. Siltstone, 20%, as above.
2050 - 2060	Sandstone, 100%, as above with patchy to even brown oil stain, blue-white sample and cut fluorescence.
2060 - 2065	Shale, 100%, dark gray to black, firm to hard, very bituminous and silty.
2065 - 2110	Sandstone, 100%, light to medium gray-brown. Moderately hard, very fine to fine-grained, well sorted, very calcareous, silty, poor porosity, with trace oil stain and sample and cut fluorescence as above.
2110 - 2140	Siltstone, 100%, dark gray, shaly, subfissile, calcareous grading to sandstone.
2140 - 2160	Sandstone, 100%, light to medium gray, fine to medium-grained, fair porosity, subangular, poorly sorted with trace chert fragments, sample fluorescence and cut.
2160 - 2210	Sandstone, 100%, as above with traces of pyrite and pyrobitumen.
2210 - 2220	Siltstone, 100%, dark gray, calcareous, pyritic, grading to sandstone, as above.
2220 - 2230	Sandstone, 100%, as above, very calcareous, with skeletal limestone fragments, fossiliferous with bryozoa, brachiopods and echinoid spines, pyrite and trace of kaolin.
2230 - 2250	Sandstone, 100%, light gray, fine to coarse-grained, poorly sorted, subangular, fair porosity, very calcareous.
2250 - 2270	Sandstone, 100%, dark gray, fine-grained, well sorted grading to siltstone, calcareous with fossils mainly bryozoa, even brown oil stain, dull yellow sample and cut fluorescence.

2270 - 2280	Limestone, 100%, gray to brown, microcrystalline, hard, arenaceous, grading to siltstone and minor sandstone, trace oil stain with sample and cut fluorescence.
2280 - 2320	Dolomite, 50%, dark gray, moderately hard, microcrystalline, massive, silty. Sandstone, 30%, as above. Siltstone, 20%, medium to dark gray, firm to moderately hard, calcareous grading to sandstone with poor trace chert and bryozoa.
2320 - 2350	Siltstone, 100%, gray to brown, hard, dolomitic with calcite in fractures, fossiliferous with bryozoa and fish remains.
2350 - 2370	Sandstone, 100%, white to dark gray, fine to coarse-grained, poorly sorted, subrounded to subangular, calcareous, fair porosity, with occasional lithic fragments, abundant pyrite and pyrobitumen.
2370 - 2380	Chert, 50%, gray to blue-gray, very hard. Conchoidal fracture, cryptocrystalline, translucent with disseminated pyrite and rare sponge spicules. Sandstone, 50%, as above.
2380 - 2430	Sandstone, 100%, light gray to tan, fine to medium-grained, well sorted, subrounded, slightly calcareous becoming quartzitic.
2430 - 2440	Dolomite, 100%, medium gray, microcrystalline, hard, massive, silty.
2440 - 2450	Sandstone, 100%, gray-brown, fine to medium-grained, poorly sorted, subrounded, fair porosity, calcareous.
2450 - 2480	Siltstone, 100%, medium brown to gray, moderately hard, poor porosity, calcareous and dolomitic grading to fine-grained sandstone.
2480 - 2505	Limestone, 100%, dark gray, hard, brittle, microcrystalline, very silty grading to calcareous siltstone, slightly shaly.
2505 - 2520	Sandstone, 100%, light gray to tan, fine-grained, subrounded, well sorted, very calcareous, fair porosity, with trace dead oil stain.
2520 - 2540	Sandstone, 100%, gray to brown, fine to medium grained, poorly sorted, subangular, very calcareous grading to siltstone.

2540 - 2560	Siltstone, 100%, dark brown to gray, firm friable, dolomitic grading to sandstone, as above.
2560 - 2580	Sandstone, 100%, gray-brown, very fine to fine-grained, moderately sorted, subangular, dolomitic grading to siltstone as above with trace of shaly siltstone.
2580 - 2630	Sandstone, white to tan, fine-grained. Moderately sorted, fair porosity, subangular, calcareous with dead oil stain.
2630 - 2645	Limestone, white to light brown, hard, microcrystalline and very silty.
2645 - 2650	Sandstone, as above.
2650 - 2680	Sandstone, white to light gray. Fine-grained, moderately sorted, subrounded, friable, fair porosity grading to siltstone.
2680 - 2690	Dolomite, brown to dark gray, hard, microcrystalline to crystalline, very silty with a thin chert band.
2690 - 2720	Sandstone, white, fine to very fine, subangular, fair sorting, fair to good porosity grading to quartzite.
2720 - 2750	Sandstone, white to light gray, very fine to fine, moderately sorted, subrounded, quartzose, occasionally silty and slightly dolomitic.
2750 - 2760	Dolomite, gray to brown, hard, crystalline, very silty, fossiliferous.
2760 - 2800	Sandstone, white, fine to medium grained, poorly sorted, subrounded to subangular, fair to good porosity, dolomitic.
2800 - 2820	Sandstone, white to light gray, very fine to fine, moderately sorted, quartzose, dolomitic cement, poor porosity.
2820 - 2840	Sandstone, gray, very fine, well sorted, subrounded, poor porosity, interbedded with siltstone and shale.
2840 - 2850	Sandstone, white to gray, very hard, fine grained, quartzitic and dolomitic.
2850 - 2880	Sandstone, white, very hard, quartizic, very fine, well sorted, dolomitic and poor porosity.

2880 - 2900	Siltstone, gray to brown, moderately hard, shaly, very pyritic.
2900 - 2920	Sandstone and siltstone interbedded, white to gray, trace green, dolomitic, poor to fair porosity.
2920 - 2930	Sandstone, white to gray, fine to very fine, hard, moderately sorted, subrounded to subangular, poor porosity.
2930 - 2950	Siltstone, dark brown, moderately hard, generally massive, poor porosity with trace of dolomitic cement.
2950 - 2960	Shale, dark gray to black, subfissil, slightly dolomitic and very pyritic.
2960 - 3000	Sandstone, gray to light brown, fine to coarse, poorly sorted, subangular to subrounded with fair porosity.
3000 - 3020	Sandstone, medium to dark gray, fine to medium grained, poorly sorted, subangular, subrounded, fair porosity, slightly dolomitic.
3020 - 3060	Sandstone, 100%, light gray to brown, fine to medium grained, hard, poorly sorted, subangular, poor to fair porosity, siliceous cement.
3060 - 3080	Sandstone, 100%, dark brown to gray, fine to very fine, commonly silty, very hard, quartzose with dolomitic cement.
3080 - 3090	Shale, 100%, dark brown, soft to firm, friable, dolomitic with rare pyrite and trace of silty sandstone.
3090 - 3102	Sandstone, 70%, light gray, medium grained, sub-angular, hard, quartzose, shale as above, 10%, dolomite, 20%, dark brown, hard, massive and generally silty.
3102 - 3110	Sandstone, 100%, dark gray-brown, medium to fine grained, moderately hard, quartzose, subrounded, moderately sorted with trace of pyrite and pyro-bitumen; dolomitic cement.
3110 - 3120	Sandstone, 90% as above, siltstone, 10%, dark brown and very pyritic.
3120 - 3190	Sandstone as above, 100%.
3190 - 3200	Sandstone as above, 100%, becoming occasionally coarse grained with trace of dark brown siltstone.

3200 - 3210	Sandstone, 100%, medium to dark gray, fine to very fine grained, moderately hard, subrounded, quartzose with minor accesory pyrite. Generally oil stained.
3210 - 3230	Sandstone, 80% as above, grading to silty sandstone, 20%, dark gray-brown, quartzose and pyritic.
3230 - 3250	Sandstone, 70% as above, silty sandstone, 15% as above, siltstone, 15%, dark gray, firm, friable, noncalcareous.
3250 - 3260	Sandstone, 100%, as above.
3260 - 3270	Sandstone, 90%, medium gray, fine to very fine-grained, quartzose, subrounded, moderately hard with trace bitumen. Siltstone, 10%, light gray, firm friable with minor pyrite.
3270 - 3320	Sandstone, 100%, light to medium gray, medium to very fine-grained, moderately sorted, subrounded, hard, occasionally calcareous.
3320 - 3350	Sandstone, 100%, light gray, fine-grained, subrounded, moderately hard and slightly to moderately calcareous.
3350 - 3390	Sandstone, 80% as above becoming subangular and moderately calcareous. Siltstone, 20%, dark brown, firm, friable, pyritic and noncalcareous.
3390 - 3400	Sandstone, 90%, fine-grained, slightly calcareous, subrounded, moderately sorted, moderately hard. Shale, 10%, dark gray, fissile, friable, noncalcareous.
3400 - 3410	Sandstone, 100%, light-dark gray, fine-grained, subrounded with calcareous cement and quartzose.
3410 - 3440	Sandstone, 50%, light-dark brown, equigranular, calcareous,subrounded, moderately hard. Siltstone, 40%, dark brown, firm friable, slightly dolomitic. Shale, 10%, dark brown, firm, friable, fissile, silty in part and pyritic.
3440 - 3450	Shale, 100%, black, firm, subfissile, silty and pyritic.
3450 - 3500	Sandstone, 100%, dark gray to brown, fine-grained, quartzose, very hard, poor porosity, interbedded with siltstone. Even brown dead oil stain.
3500 - 3540	Sandstone, 100%, white to light gray, firm, friable, fine to medium-grained, moderately sorted, subangular

	to subrounded, fair porosity, weak calcareous cement. Patchy dead oil stain.
3540 - 3550	Siltstone, 100%, dark gray to brown, hard becoming subfissile and shaly, pyritic.
3550 - 3570	Shale, 100%, brown to dark gray, hard, fissile, noncalcareous to slightly calcareous, very silty and pyritic.
3570 - 3580	Sandstone, 100%, light to dark gray, hard, very fine to fine-grained, subangular to subrounded, poor porosity, abundant pyrite.
3580 - 3610	Sandstone, 100%, dark to light gray, very fine to fine-grained, hard, calcareous, well sorted, subrounded.
3610 - 3640	Siltstone, 100%, light gray to brown, firm to hard, sandy, argillaceous becoming fissile, very calcareous and very pyritic. Trace arenaceous limestone.
3640 - 3660	Siltstone, 100%, gray, hard, sandy, argillaceous, pyritic, fossiliferous.
3660 - 3690	Shale, 100%, light gray, firm, fissile, very silty, calcareous.
3690 - 3710	Limestone, 100%, brown to dark gray, hard, microcrystalline to crystalline, argillaceous, arenaceous, fossiliferous.
3710 - 3720	Sandstone, 100%, white to light gray, hard, very calcareous grading to siltstone.
3720 - 3730	Shale, 100%, pale gray, moderately hard, subfissile, very silty.
3730 - 3745	Siltstone, 100%, dark to light gray, subfissile, hard, sandy, calcareous.
3745 - 3750	Shale, 100%, dark gray to black, hard, fissile and silty.
3750 - 3760	Limestone, 100%, gray, occasionally light gray, hard, silty with pyritized fossils.
3760 - 3770	Siltstone, 100%, gray, subfissile, calcareous, fossiliferous.
3770 - 3780	Shale, 100%, dark gray to black, subfissile, hard, calcareous, fossiliferous.
3780 - 3790	Siltstone, 100%, gray, hard, silicified, sandy, calcareous, argillaceous, fossiliferous.

3790 - 3800	Sandstone, 100%, light brown, very hard, siliceous, calcareous, silty, some shale.
3800 - 3830	Shale, 100%, black to dark gray, hard, fissile, dolomitic and pyritic.
3830 - 3840	Siltstone, 100%, dark gray, hard, subfissile, dolomitic, sandy, pyritic and carbonaceous.
3840 - 3850	Dolomite, 70%, brown-gray, cryptocrystalline to microcrystalline, blocky, occasionally splintery, very hard, angular, fractures, occasionally shaly and silty. Shale, 10%, black to dark gray, moderately hard, fissile, occasionally pyritic, slightly dolomitic. Siltstone, 10%, gray, moderately hard, argillaceous, slightly dolomitic, sandy in part. Sandstone, 10%, light brown to light gray, occasionally white, slightly calcareous, well sorted, fine-grained, subangular to subrounded.
3850 - 3860	Dolomite, 40% as above. Shale, 30% as above. Siltstone, 30% as above with loose calcite fragments possibly from a fracture.
3860 - 3870	Dolomite, 90% as above. Shale, 10% as above.
3870 - 3890	Dolomite, 20% as above. Shale, 80% as above.
3890 - 3900	Shale, 50% as above, noncalcareous. Dolomite, 30% as above. Siltstone, 20% as above.
3900 - 3910	Siltstone, 50%, gray, moderately hard to hard, argillaceous, sandy, calcareous, blocky, occasionally pyritic. Sandy siltstone, 20%. Shale, 20%, dark gray, fissile, fine to moderately hard, occasionally micaceous. Limestone, 10%, brown-gray, dolomitic, abundant crinoids and molluscs, silty in part, some coarse calcite.
3910 - 3920	Sandy siltstone, 40%. Siltstone, 30% as above. Limestone, 10% as above. Dolomite, 10%, brown-gray, cryptocrystalline to microcrystalline, blocky, occasionally splintery with angular fracture. Sandstone, 10%, white to light brown-gray, very fine-grained, dolomitic, moderately well sorted becoming silty grading to siltstone.
3920 - 3930	Siltstone, 40% as above becoming very sandy and very calcareous. Sandy siltstone, 30%. Limestone, 20% as above becoming very silty grading to siltstone. Sandstone, 10% as above.

3930 - 3940	Siltstone, 20%. Sandy siltstone, 20%. Dolomite, 20%. Limestone, 20% with abundant crinoids. Shale, 10%. Sandstone, 10%, interbedded.
3940 - 3950	Sandstone, 80%. Siltstone, 10%. Sandy siltstone, 10% as above.
3950 - 3970	Sandstone, 40%, brown-gray, very fine-grained, quartzose, moderately hard, dolomitic cement, pinpoint to poor porosity, grading to sandy siltstone 20%, grading to siltstone 40%, gray, moderately hard, moderately well sorted, micaceous.
3970 - 3980	Sandstone, 40% as above. Sandy siltstone, 20% as above. Siltstone, 30%, dark gray, firm to moderately hard, poorly sorted, micaceous, calcareous becoming arenaceous. Dolomite, 10%, gray-brown, hard, angular fracturing, cryptocrystalline.
3980 - 3990	Siltstone, 50% as above. Limestone, 20%, brown-gray, splintery to blocky, very hard, cryptocrystalline grading to dolomite, 10% as above. Sandstone, 10%, becoming calcareous, dense, hard. Sandy siltstone,10%.
3990 - 4000	Shale, 90%, dark gray, firm to moderately hard, fissile, non-calcareous, silty in part, occasionally pyritic, occasionally micaceous. Siltstone, 10% as above.
4000 - 4020	Limestone, 70-90%, white to light gray, hard, medium to cryptocrystalline, occasionally chalky, blocky, splintery, some fracturing, fossiliferous with molluscs. Shale, 10-20% as above with some microfossils. Siltstone, 0-10% as above, pyritic in part.
4020 - 4030	Shale, 70%, dark gray as above, calcareous grading to siltstone, 20% as above. Limestone, 10% as above.
4030 - 4080	Shale, 70-90%, dark gray-brown, firm, fissile, non-calcareous, silty in part with pyrite and fossils. Siltstone, 10-30%, dark gray-brown, well sorted, firm, dolomitic, grading to shale as above.
4080 - 4090	Siltstone, 70%, dark gray, argillaceous, moderately hard, pyritic, calcareous, fossiliferous with crinoids. Shale, 30% as above, becoming slightly dolomitic.
4090 - 4110	Shale, 80%, dark gray to black, firm to moderately hard, fissile, non to slightly calcareous, splintery, occasionally blocky, occasionally micaceous. Limestone, 10-20%, white to light gray, hard, blocky, occasionally splintery, occasionally chalky, cryptocrystalline to medium crystalline, some fracturing with fossils predominantly crinoids. Siltstone, 0-10% as above.

4110 - 4120	Siltstone, 80%, dark gray, argillaceous, moderately hard, blocky, calcareous, occasionally pyritic with pyritized fossils predominantly molluscs and crinoids. Shale, 10% as above. Sandstone, 10%, tan, very fine-grained, hard, quartzose, calcerous cement, well sorted, subangular, tight.
4120 - 4130	Shale, 50% as above. Limestone, 40% as above, light brown in part, dolomitic, in part with calcite, blocky. Siltstone, 10% as above.
4130 - 4140	Sandstone, 90%, tan, very fine to fine-grained, moderately hard, occasionally friable, well sorted, calcareous cement, silty in part, subangular, poor porosity with microfossils and crinoids. Shale, 5% as above. Siltstone, 5% as above, becoming sandy.
4140 - 4150	Sandstone, 80%, buff, tan, subrounded to subangular, quartzose, moderately hard to hard, well sorted, calcareous, poor porosity with crinoids, pyrite and microfossils. Shale, 10%, dark gray to black, firm, fissile, calcareous, occasionally micaceous. Siltstone, 10%, dark gray to brown, poor to moderately well sorted, argillaceous in part, slightly calcareous, moderately hard to hard.
4150 - 4170	Shale, 50-60% as above. Siltstone, 30% as above. Sandstone, 10-20% as above.
4170 - 4210	Shale, 70-90%, dark gray to black, fissile, occasionally blocky, slightly calcareous, slightly micaceous with pyrite. Siltstone, 10-30% as above, moderately hard, traces of limestone, tight, sandstone as above and sandy siltstone.
4210 - 4220	Siltstone, 40% as above, sandy in part. Shale, 30% as above, becoming more micaceous and silty. Sandstone, 20% as above. Sandy siltstone, 10%.
4220 - 4230	Shale, 40%, dark gray to black, firm to moderately hard, fissile, occasionally blocky, slightly micaceous, slightly calcareous, silty. Siltstone, 40%, dark gray to brown, firm to moderately hard, blocky, slightly calcareous, occasionally micaceous, poor to moderately well sorted, sandy in part. Sandy siltstone, 10%. Sandstone, 10%, tan, fine-grained, hard, slightly calcareous, subrounded to subangular, tight to pinpoint porosity.
4230 - 4250	Shale, 50%, dark gray to brown, black, micaceous, as above. Siltstone, 50% as above, well sorted.
4250 - 4270	Siltstone, 70% as above, medium well sorted, very sandy in part with shaly laminations and crinoids. Shale, 15% as above, slightly micaceous, noncalcareous,

	very silty in part. Sandy siltstone, 15%.
4270 - 4280	Sandstone, 100%, light brown to cream, very fine to fine-grained quartzose, very hard, occasionally friable, slightly calcareous, very slightly micaceous to micromicaceous, subangular with trace of fossils.
4280 - 4290	Sandstone, 80% as above. Shale, 10% as above, noncalcareous. Siltstone, 10% as above, noncalcareous with pyrite and some white cream calcite fracturing.
4290 - 4310	Shale, 70% as above. Siltstone, 20-30% as above. Sandstone, 0-10% as above.
4310 - 4320	Siltstone, 60% as above. Shale, 30% as above. Sandy siltstone, 10%, slightly calcareous.
4320 - 4360	Siltstone, 60-80%, dark gray, moderately well sorted, firm to moderately hard, slightly calcareous, micaceous, subfissile, occasionally argillaceous with pyrite and crinoid and mollusc fragments. Shale, 20-40%, dark gray-black, firm to moderately hard, fissile, occasionally subfissile, splintery, noncalcareous, occasionally blocky with trace of calcite veining and pyrite.
4360 - 4370	Shale, 70% as above. Siltstone, 30% as above.
4370 - 4390	Sandstone, 70-80%, light gray brown, fine to very fine-grained, subangular to subrounded, well sorted, poor porosity, slightly calcareous, hard, occasionally friable, quartzose. Siltstone, 0-20% as above. Shale, 10% as above. Sandy siltstone, 10%.
4390 - 4420	Sandstone, 100% as above, light brown, subangular, noncalcareous, quartzose, silty in part with loose calcite more evident near base, becoming more friable near base. Trace of sandy siltstone and siltstone as above.
4420 - 4430	Sandstone, 90% as above. Sandy siltstone, 10%.
4430 - 4450	Sandstone, 40% as above. Siltstone, 30% as above, becoming more micaceous, noncalcareous. Sandy siltstone, 20%. Shale, 10% as above, very silty in part, noncalcareous, micromicaceous.
4450 - 4460	Siltstone, 40%, dark gray, poorly sorted, argillaceous in part, firm to medium hard, noncalcareous, micromicaceous, subfissile with pyrite and occasional crinoids. Sandstone, 30%, light brown, very fine to fine-grained, slightly calcareous, quartzose, subangular, hard, occasionally friable, silty in part. Sandy siltstone, 20%. Shale, 10%, dark gray to black, firm to

	medium hard, fissile, occasionally subfissile, splintery, noncalcareous, occasionally blocky with trace of calcite fragments and pyrite.
4460 - 4480	Siltstone, 50% as above, medium well sorted. Sandy siltstone, 30% as above. Sandstone, 10% as above. Shale, 10% as above. Trace of dolomite, gray brown, blocky, hard.
4480 - 4520	Siltstone, 60-80% as above, very micromicaceous. Sandy, 10-30% as above. Shale, 0-20% as above.
4520 - 4530	Shale, 50% as above, dark gray fissile, moderately hard silty in part, micromicaceous with occasional pyrite. Siltstone, 40% as above. Sandy siltstone, 10% as above.
4530 - 4540	Siltstone, 70%, dark gray, firm to moderately hard, well sorted, noncalcareous, very poor porosity subfissile, micromicaceous with a trace of pyrite. Shale, 30%, dark gray, moderately hard, micromicaceous, fissile, noncalcareous.
4540 - 4550	Shale, 60% as above. Siltstone, 30% as above. Sandstone, 10%, light to medium gray, brown, very fine to fine-grained, moderately sorted, calcareous.
4550 - 4590	Sandstone, 40%, gray brown, very fine to fine-grained, angular to subangular, hard, generally noncalcareous with occasional shaly laminations grading to silty sandstone, 20%. Siltstone, 30%, dark gray, brown, firm to moderately hard, micromicaceous, well sorted with faint trace of dolomitic cement and blocky fracture. Shale, 10% as above.
4590 - 4620	Siltstone, 80% as above. Silty sandstone, 10% as above. Shale, 10% as above.
4620 - 4650	Siltstone, 90%, black to dark gray, moderately hard, subfissile and shaly to argillaceous in part. Shale, 10%, dark gray, firm to moderately hard, noncalcareous, micromicaceous and fissile.
4650 - 4660	Siltstone, 80% as above. Shale, 10% as above. Sandstone, 10%, medium gray, very fine-grained, subangular, hard, well sorted, moderately calcareous and quartzose.
4660 - 4670	Shale, 20% as above. Siltstone, 50% generally as above. Silty sandstone, 10%. Sandstone, 20% as above.
4670 - 4690	Siltstone, 80% as above. Silty sandstone as above. Sandstone, 10% as above

4690 - 4710	Siltstone, 80%, as above. Silty sandstone as above. Sandstone, 10% as above.
4710 - 4760	Siltstone, 40%, dark gray, moderately sorted, moderately hard, slightly calcareous, increasingly arenaceous. Sandstone,10%, medium gray, very fine-grained, hard, well sorted, subangular, moderately calcareous.
4760 - 4780	Siltstone, 40% as above. Silty sandstone, 40% as above. Sandstone, 10% as above. Dolomite, 10%, medium gray, hard, massive, blocky fractures, speckled.
4780 - 4790	Siltstone, 40% as above. Silty sandstone, 20% as above. Sandstone as above. Dolomite, 10% as above. Limestone, 20%.
4790 - 4820	Silty sandstone, 70%, medium grained, compact, hard, well sorted, slightly calcareous and quartzose. Siltstone, 20%, medium to dark gray, moderately hard, subfissile, occasionaly with blocky fractures, slightly dolomitic and argillaceous in part. Sandstone, 10%, light to medium gray, very fine-grained, angular to subangular, very hard, sucrose, quartzose, slightly calcareous and grading to silty sandstone, as above.
4820 - 4870	Shale, 20%, dark gray, moderately hard, fissile, micaceous and slightly dolomitic. Siltstone, 60% as above. Silty sandstone, 20% as above.
4870 - 4890	Shale, 20% as above. Siltstone, 40% as above. Silty sandstone, 30% as above. Sandstone, 10% as above.
4890 - 4910	Shale, 10%. Siltstone, 50%. Silty sandstone, 40%.
4910 - 4930	Shale, 20%. Siltstone, 40%. Silty sandstone, 30%. Sandstone, 10%.
4930 - 4940	Shale, 30%. Siltstone, 40%. Silty sandstone, 30%.
4940 - 4970	Shale, 70%, dark gray to black, moderately hard, fissile, silty, laminated and noncalcareous. Siltstone, 20%, dark gray to black, moderately hard, slightly dolomitic and micromicaceous. Silty sandstone,10%, light medium gray, moderately sorted, quartzose.
4970 - 5030	Shale, 80%, dark gray to black, moderately hard, fissile with thin shaly partings, slightly calcareous and pyritic. Siltstone, 20% as above, and a trace of limestone and dolomite.

5030 - 5050	Siltstone, 60%, dark gray, firm to moderately hard, moderately sorted, blocky, fractures, argillaceous, slightly calcareous with trace of pyrite. Shale, 40% as above.
5050 - 5070	Shale, 60% generally as above. Siltstone, 20% as above. Silty sandstone, 20%, medium gray to brown, very fine to fine-grained, moderately hard, friable, very calcareous, generally poorly sorted and includes crinoid fragments with poor porosity.
5070 - 5100	Shale, 70%, dark gray, firm, fissile, noncalcareous and becoming silty to include siltstone, 30% as above.
5100 - 5180	Shale, black, moderately hard, fissile, silty.
5180 - 5200	Sandstone, gray to brown, hard, fine to very fine, Moderately well sorted, subgrounded, calcareous, pryitic.
5200 - 5220	Siltstone, brown to gray, hard, sandy, argillaceous and micromicaceous.
5220 - 5240	Siltstone, 100% dark gray, moderately hard, argillaceous, blocky becoming sandy and micromicaceous.
5240 - 5260	Shale, 100% black moderately hard, fissile, silty and moderately calcareous.
5260 - 5290	Shale, 60%, dark gray to black, fissile, moderately hard. Siltstone, 40% dark gray, blocky, hard, micaceous, becoming sandy, slightly calcareous.
5290 - 5430	Shale, 100% dark gray to black, moderately hard, fissile, occasionally blocky, non to slightly calcareous, slightly silty, abundant pyrite.
5430 - 5460	Shale, 80% as above. Siltstone, 20%.
5460 - 5530	Shale, 100% gray to black, fissile to blocky, firm to moderately hard, non to slightly calcareous, micaceous, pyritic and occasionally silty.
5530 - 5540	Shale, 50% as above. Sandstone, 50% gray, very fine grained, subangular, hard to very hard, slightly calcareous.
5540 - 5570	Chert, 100% white to light gray, very hard, cryptocrystalline, massive, spicular.
5570 - 5590	Sandstone, 100% white, hard, quartzitic, dolomitic, grading to chert with thin shale partings.

5590 - 5610	Dolomite, 100% gray to pinkish brown, hard, massive, microcrystalline, sandy, trace of chert.
5605	Top Flett.
5610 - 5630	Dolomite, 30% gray, blocky, hard, microcrystalline. Shale, 70% black, moderately hard, fissile.
5630 - 5710	Shale, 100% as above.
5710 - 5750	Shale, 40% as above. Dolomite, 30%, pinkish brown, hard, cryptocrystalline. Marlstone, 30% light gray, soft to firm, grading to limestone.
5750 - 5770	Shale, 100% dark gray to black, moderately hard, fissile.
5770 - 5830	Shale, 100%, dark gray to black, firm to moderately hard, fissile, non to slightly calcareous with abundant calcite veining.
5830 - 5870	Shale, 100%, dark gray, moderately hard, fissile to blocky, slightly silty.
5870 - 5890	Shale, 60% as above. Limestone, 20%, brown to gray, soft to firm, laminated, slightly dolomitic.
5890 - 5910	Limestone, 100%, brown to gray, hard, cryptocrystalline, slightly dolomitic, fossiliferous (crinoids and brachiopods).
5910 - 5970	Shale, 100%, gray to dark gray, moderately hard, fissile, calcareous grading to marlaceous, thin stringers of dolomite.
5970 - 6140	Shale, 100%, gray to dark gray to black, occasionally brown gray, fissile, occasionally blocky, micromicaceous, silty in part, marly in part, particularly near the base, calcareous, firm to moderately hard, splintery with pyrite and occasional calcite veins.

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5990 - 6010	Limestone, 15%, white to light gray, hard, tight, medium to coarsely crystalline with fossils.
6010 - 6020	Dolomite, 10%, brown gray, hard, crystalline, silty argillaceous in part, calcite veins.
6040 - 6060	Dolomite, 5% as above. Marlstone, 5%, light gray, soft, very calcareous, argillaceous.

6080 - 6090	Dolomite, 5% as above. Marlstone, 5% as above.
6090 - 6100	Siltstone, 50%, brown gray, blocky, very calcareous, argillaceous, grading to marlstone.
6100 - 6140	Dolomite, 5% as above. Marlstone, 5% as above. Siltstone, 5% as above.
6140 - 6240	Shale, 100% dark gray to black, occasionally gray, fissile, firm to medium hard, very slightly calcareous, splintery, occasionally soft with pyrite.

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6140 - 6150	Marl, 10% light gray to cream, soft to firm, very calcareous, silty in part.
6150 - 6200	Siltstone, 10% dark gray, occasionally brown gray, blocky, firm to moderately hard, calcareous, argillaceous.
6160 - 6170	Marl, 10% as above.
6200 - 6210	Marl, 5% as above.
6240 - 6250	Shale 85%, dark gray to black, hard, fissile, silty in part, brittle fracture, noncalcareous with trace of pyrite. Siltstone, 10%, dark gray to black, firm to moderately hard, calcareous with pyrite. Marl, 5%, gray, soft, silty calcareous.
6250 - 6260	Shale, 80% as above.
6260 - 6330	Shale, 100%, silty in part as above, becoming cherty at base with trace pyrite and calcite veining and trace siltstone.
6330 - 6340	Shale, 70% as above becoming calcareous. Limestone, 20%, dark gray, mottled brown gray, blocky, very silty, hard, argillaceous, shaly in part with loose calcite fracture fragments. Siltstone, 5% as above. Marl, 5% as above.
6340 - 6360	Limestone, 80% as above. Marl, 10% as above. Shale, 10% as above.
6360 - 6370	Shale, 60% as above, marly, calcareous. Marl, 20% as above. Limestone, 10% as above. Siltstone, 10% as above, very calcareous.
6370 - 6420	Limestone, 80-100%, dark gray with brown mottling as above, some cream to light brown, blocky, argillaceous,

	calcilutite, marly in part becoming microcrystalline near base, white to light gray microcrystalline to fine crystalline, all tight. Marl, 0-10% as above. Shale, 0-10% as above.
6420 - 6580	Limestone, 70-100%, dark gray, occasionally black, Hard, blocky, occasionally mottled brown-gray, tight, silty, argillaceous in part, microcrystalline, occasionally cryptocrystalline, some cream white to light brown to light gray, soft to firm calcilutite, argillaceous, microcrystalline, occasionally fine crystalline, chalky in part, tight with calcite fractures. Shale, 0-20%, dark gray to black, occasionally light gray, firm to moderately hard, fissile, non to slightly calcareous. Silty in part with pyrite. Siltstone, 0-20%, dark gray, brown-gray, blocky, subfissile, occasionally fissile, micromicaceous, calcareous, grading in part to limestone. Marl, 0-10%, brown-gray, occasionally buff, soft to firm, predominately blocky.
6580 - 6590	Shale, 50% as above, becoming very calcareous in part, grading to shaly limestone. Limestone, 40% as above. Siltstone, 10% as above.
6590 - 6600	Shale, 70% as above. Limestone, 20% as above. Siltstone, 10% as above.
6600 - 6620	Shale, 90-95% as above. Siltstone, 0-10% as above. Limestone, 0-5% as above with abundant, loose calcite fracture fragments.
6620 - 6670	Shale 90-100%, dark gray to black, firm to moderately hard, occasionally hard, calcareous, traces of coal and pyrite. Limestone 0-10%, light gray, moderately hard, microcrystalline, argillaceous, blocky fractures, calcareous grading to silty shale.
6670 - 6730	Shale, 40-70% as above, becoming more silty. Limestone, 30-50%, medium to dark gray, firm to moderately hard, argillaceous, grading to 0-10% siltstone, dark gray, moderately calcareous, firm with rare pyrite. Marl, 0-10%, light gray-brown, firm, very calcareous, silty in part.
6730 - 6740	Shale, 75% as above, becoming very calcareous, grading to limestone. Limestone, 20%, as above, shaly. Marl, 5% as above.
6740 - 6760	Shale, 50% as above. Limestone, 35% as above, some brown cream, hard, microcrystalline, very cherty. Chert, 15%, light gray to white to brown, hard crystalline, blocky, occasionally calcareous with abundant sponge specules.

6760 - 6810	Shale, 60-80%, as above, occasionally hard, brittle, grading to dark gray, silty, limestone with thin calcite grading. Limestone, 5-30%, as above, silty in part, grading to siltstone, grading to shale, some brown-white. Marl 5-20%, as above, predominately blocky. Chert, 0-5% as above.
6810 - 6910	Shale, 45-75%, gray to dark gray, firm to moderately hard, fissile, slightly to very calcareous, silty in part. Limestone, 20-55%, medium to dark gray, micro-crystalline to argillaceous, firm to moderately hard, occasionally subfissile, generally blocky, grading to shale as above. Marl, 0-5%, medium gray, soft, silty, very calcareous.
6910 - 6940	Shale, 60-70%, gray, occasionally dark gray to black, moderately hard, occasionally hard, fissile, occasionally subfissile, calcareous, silty in part with thin calcite veining. Limestone, 10-30% as above, brown cream, cherty, silty and shaly in part. Marl, 10-20%, light brown-gray, soft to firm, very calcareous, very silty in part, blocky, moderately hard, occasionally hard, grading to siltstone.
6940 - 6960	Shale, 60-85% as above, becoming very silty. Marl, 10-30% as above. Limestone, 0-5% as above.
6960- 6970	Shale, 40%. Marl, 30%. Limestone, 30% as above, gradational.
6970 - 7000	Shale, 60-85%, light gray to black, becoming less silty. Marl, 10-20% as above, predominantly very silty, moderately hard, grading to siltstone. Lime-stone, 5-10% as above, very silty.
7000 - 7170	Shale, 65-90%, dark gray to dark brown to black. Moderately hard, fissile, brittle, slightly to very calcareous, occasionally noncalcareous, silty in part grading to siltstone and marl with calcite veining, pyritized fossils. Limestone, 5-30%, dark gray, brown cream, hard, occasionally friable, blocky, micocrystalline, occasionally cryptocrystalline, some argillaceous, tight, very silty, occasionally cherty, occasionally arenaceous. Marl, 0-30%, light brown-gray, soft to firm, argillaceous, very calcareous, very silty in part.
7170 - 7250	Shale, 100%, dark gray, moderately hard, fissile, calcareous, silty grading to siltstone and marl. Occasional limestone stringers.
7250 - 7360	Limestone, 50%, dark gray to black, hard, micro to cryptocrystalline, cherty, abundant calcite veining. Shale, 50% as above.

7360 - 7470	Limestone, 60%, dark gray, occasionally buff to white, crystalline to cryptocrystalline, moderately hard to hard, blocky, massive, argillaceous, occasionally silty, pyritic, abundant calcite veinings, fossiliferous. Shale, 40%, dark gray to black, moderately hard, fissile, non- to very calcareous grading to marl.
7470 - 7570	Limestone, 50%, dark gray, microcrystalline to cryptocrystalline, massive, blocky fractures, hard and occasionally becoming silty to arenaceous with a trace of marl and grading to shale. Shale, 50%, dark gray to black, fissile, moderately hard, slightly calcareous and occasionally silty.
7570 - 7590	Shale, 65% as above. Limestone, 35% as above.
7590 - 7620	Shale, 60%, dark gray to gray, firm to moderately hard, fissile, slightly to very calcareous, occasionally micromicaceous to silty with pyrite and a trace of fossils. Limestone, 40%, white to cream, brown to dark gray, predominantly hard, microcrystalline, occasionally fine crystalline, argillaceous with some loose calcite.
7620 - 7640	Limestone, 40% as above. Shale, 50% as above. Chert, 10%, brown, translucent, very hard, blocky fractures with small calcite inclusions.
7640 - 7650	Limestone, 70%, generally white to cream, occasionally silty, fine crystalline to microcrystalline, tight to pinpoint porosity, generally calcilutite. Shale, 15% as above. Chert, 15% as above.
7650 - 7700	Limestone, 80% as above. Shale, 20% as above.
7700 - 7720	Limestone, 60%, white to cream to dark gray, cherty in part, chalky, calcilutite with fine desseminated pyrite, finely crystalline and pinpoint porosity. Shale, 40% dark gray to black, fissile, moderately hard, slightly calcareous, occasionally micromicaceous and silty.
7720 - 7770	Limestone, 80% as above. Shale, 10% as above. Chert, 10%, dark brown to black, very hard, conchoidal to splintery fracture, translucent in thin flakes, cryptocrystalline, glassy and with calcite veining commong.
7770 - 7850	Limestone, 70% as above. Chert, 30% as above.

7850 - 7860	Limestone, 75%, dark gray, hard, microcrystalline, argillaceous to arenaceous, massive, occasionally sucrose. Shale, 15%, dark gray to black, moderately hard, fissile, micromicaceous in part, becoming silty and slightly to noncalcareous. Chert, 10%, dark brown to black, very hard, conchoidal to splintery fracture, cryptocrystalline, translucent in thin flakes, with abundant calcite veining.
7860 - 7880	Limestone, 70% as above. Shale, 30% as above.
7880 - 7890	Limestone, 60% as above. Shale, 40% as above.
7890 - 7910	Limestone, 50-55%, dark gray, occasionally black, cryptocrystalline, some microcrystalline, massive, blocky, silty in part, some brown cream, argillaceous, chalky with some loose calcite fractures. Shale, 40-50%, dark gray to black, fissile, non- to slightly calcareous, occasionally silty, occasionally micro-micaceous. Marl, 0-5%, light gray-brown, soft to firm, silty, shaly in part, very argillaceous, very calcareous.
7910 - 7920	Shale, 70% as above. Limestone, 20% as above. Marl, 10% as above.
7920 - 7930	Shale, 50%, dark gray to black, fissile, hard, splintery, very calcareous, silty in part, some medium gray, moderately hard, subfissile in part, non- to slightly calcareous with thin calcite veining. Limestone, 40%, dark gray to black, blocky, hard to very hard, micro-crystalline, shaly and silty in part grading to shale as above. Marl, 10%, light brown-gray, firm, occasionally soft, silty in part, very calcareous, very argillaceous.
7930 - 7940	Shale, 50% as above. Marl, 30% as above. Limestone, 20% as above.
7940 - 7950	Shale, 50%. Limestone, 40%, Marl, 10%.
7950 - 7960	Limestone, 50%. Shale, 40%. Marl, 10%.
7960 - 7970	Limestone, 70%. Shale, 30%, all as above.
7970 - 7980	Limestone, 55%, increase in loose calcite fracture fragments. Shale, 40%. Dolomite, 5%, light brown, hard, pyritic in part, traces of marl and chert.
7980 - 8030	Limestone, 40-60%, black to dark gray, hard to very hard, microcrystalline, blocky, subfissile in part, occasionally silty becoming shaly. Shale, 40-60%, dark gray-brown, noncalcareous, fissile, hard, occasionally subfissile, slightly silty, trace of fine disseminated pyrite.

8030 - 8040	Shale, 70%. Limestone, 20%. Marl, 10% as above.
8040 - 8090	Limestone, 70-80%, black to dark gray as above, some brown-gray to light gray, very silty grading to siltstone, blocky, hard, microcrystalline, argillaceous in part with some loose calcite fracture fragments and thin calcite veining, cherty in part with fine disseminated pyrite. Shale, 20-30% as above, traces of siltstone, dark brown-gray, calcareous, argillaceous, traces of marl, light brown-gray, very argillaceous, very calcareous.
8090 - 8100	Shale, 60%. Limestone, 40%.
8100 - 8130	Limestone, 70-85%, black to dark gray, hard, blocky, silty, shaly in part, some brown-gray, hard to moderately hard, argillaceous in part, predominantly tight, occasional pinpoint porosity. Shale, 15-30%, dark gray-black, moderately hard to hard, fissile, occasionally subfissile, micromicaceous to non- to slightly calcareous with calcite veining.
8130 - 8134	Milling on fish
8134 - 8169	See description for Core #1
8169 - 8180	Shale, 90%. Dark gray to black, fissile, moderately hard, occasionally subfissile, slight to very calcareous, silty with calcite fractures, pyrite, some integrating with limestone. Limestone, 5%, brown green, hard, tight, microcrystalline, fossil debris perdominantly shown. Marl, 5%, light brown, green, firm, moderately hard, very silty in part, very argillaceous, very calcareous.
8180 - 8200	Shale, 90% as above. Limestone, 10% as above, slightly silty in part, becoming marl.
8200 - 8210	Shale, 100% as above.
8210 - 8260	Shale, 40-80%, dark gray to black, fissile to subfissile, Moderately hard, non- to slightly calcareous, micromicaceous in part becoming brown-gray, silty, calcareous grading to marl. Marl, 20-60%, brown-gray, firm to Moderately hard, generally blocky, silty, very argillaceous and calcareous with some calcite veining.
8260 - 8320	Shale, 50-80% dark gray, black, moderately hard, subfissile to fissile micromicaceous, non- to slightly calcareous, occasionally very calcareous, slightly silty in part with occasional coarse mica flakes. Marl, 20-50%, light brown to medium gray, blocky, subfissile,

	firm to moderately hard, very argillaceous and calcareous becoming silty with occasional calcite veining. Limestone trace, buff to medium brown, dolomitic, hard, microcrystalline, moderate to slightly calcareous.
8320 - 8350	Shale, 30-50% as above, moderately calcareous. Marl, 20-40% as above. Limestone, 20-40% dark gray black, hard, brittle blocky, occasionally subfissile, microcrystalline in part.
8350 - 8370	Marl, 50-60% as above, becoming very silty, grading to limestone, 20-40% as above. Shale, 10-20% as above. Siltstone, 0-10%, gray brown, very calcareous, very marly.
8370 - 8380	Marl, 50% as above. Shale, 40% as above. Limestone, 10% brown-gray, occasionally black, tight, hard, blocky, silty with abundant loose calcite fracture fragments.
8380 - 8390	Shale, 90%, dark gray to black, firm to moderately hard, fissile, clean, non to slightly calcareous, occasionally silty, occasionally marly in part. Marl, 5% as above. Limestone, 5% as above.
8390 - 8400	Shale, 50% as above, becoming marly with loose pyrite. Limestone, 40%, predominantly brown-cream, firm to hard, microcrystalline to very argillaceous, chalky in part, silty in part, marly calcilutite predominant, tight, some black to dark gray, cryptocrystalline, tight. Marl, 10% as above.
8400 - 8460	Limestone, 70-90% as above with crinoids and shell fragments becoming more silty, hard, gray, brown near the base. Increase in calcite veining towards the base. Shale, 10-25% as above. Marl, 0-5% as above.
8460 - 8480	Shale, 20-40%, black, moderately hard, fissile, occasionally subfissile, micromicaceous, slightly calcareous in part. Limestone, 50-70%, dark gray-black, microcrystalline, hard, blocky, very argillaceous in part. Marl, 10%, light brown, fissile to medium hard, blocky, very argillaceous and calcareous, becoming silty.
8480 - 8630	Limestone, 90-100%, dark gray-black, hard, microcrystalline, with occasional trace crinoid fragments and trace calcite veins. Also limestone, light brown to gray, moderately hard, blocky to subfissile, occasionally very argillaceous, becoming silty, trace pyrite. Shale, 0-10%, as above, black moderately hard, fissile, non- to slight calcareous, micromicaceous.

8630 - 8720	Limestone, 50-100%, dark gray, hard, microcrystalline, blocky becoming subfissile in part with trace of calcite veining. Shale, 0-50%, dark gray to black, moderately hard, fissile, micromicaceous, noncalcareous, trace disseminated pyrite, occasional trace of very fine calcerenite, medium brown, moderately hard to hard, moderately sorted, angular to subangular.
8720 - 8810	Limestone, 0-20%, as above, dark gray, hard, microcrystalline. Shale, 80-100%, dark gray, moderately hard, fissile, noncalcareous with occasional pyrite, micromicaceous.
8810 - 9010	Shale, 90-100%, medium to dark gray, moderately hard, fissile, micromicaceous, noncalcareous, occasionally slightly silty, occasional thin calcite vein. Good trace disseminated massive pyrite. Limestone, 0-10%, dark gray, hard, blocky, microcrystalline, occasional calcite veining.
9010 - 9080	Shale, 80-100%, medium to dark gray, moderately hard, fissile, occasionally subfissile, micromicaceous, noncalcareous becoming slightly silty in part. Trace massive disseminated pyrite, occasional calcite veining. Limestone, 0-20%, dark gray, occasionally gray-brown, hard, blocky, microcrystalline, slightly dolomitic in part with some sucrosic texture, argillaceous grading to calcerenite.
9080 - 9170	Shale, 100% as above.
9170 - 9190	Shale, 90% as above. Marl, 10%,light to medium gray, moderately hard, blocky to subfissile, very argillaceous, very calcareous.
9190 - 9210	Shale, 100%, light to dark gray, moderately hard, subfissile to fissile, occasionally blocky, noncalcareous, micromicaceous in part. Thin quartz veins, occasional pyrite. Trace limestone, dark gray to gray brown, occasionally cream, very hard, argillaceous, microcrystalline, sucrosic texture.
9210 - 9230	Shale, 100%, as above becoming predominantly light gray, non- to slightly calcareous, blocky to fissile. Trace limestone as above with trace crinoid remains.
9230 - 9250	Shale, 100%, light to dark gray, black, firm to moderately hard, occasionally soft, subfissile to fissile, non- to slightly calcareous, very thin calcite veins, some loose pyrite, thin quartz veins and loose quartz. Shale occasionally becoming silty and marly grading in part to marl.

9250 - 9270	Shale, 100%, as above, becoming predominantly lighter in colour.
9270 - 9300	Shale, 100%, continuing to become predominantly light to medium gray, firm, subfissile to fissile, occasionally blocky, noncalcareous, micromicaceous. Density about 2.69 grams/cc. Quartz veins and pyrite are less evident.
9300 - 9350	Shale, 100%, light gray, occasionally medium to dark gray, firm subfissile to fissile, noncalcareous, occasionally micromicaceous; no veining.
9350 - 9390	Shale, 100%, as above, grading to traces of claystone, white to light gray, moderately soft, noncalcareous; breaks down in water.
9390 - 9560	Shale, 100%, light to medium gray, occasionally dark gray, firm, fissile, occasionally subfissile, non- to slightly calcareous, occasionally micromicaceous. occasional calcite and quartz veins, occasional loose clear angular quartz. Trace of claystone, light gray, firm, noncalcareous, nonswelling to hydrofissile grading to shale.
9560 - 9570	Shale, 100% light to medium gray, occasionally dark gray to black, firm to moderately hard, subfissile to fissile, occasionally silty, minor calcite veining, non- to slightly calcareous, occasionally micromicaceous, occasionally marly and clayey. Trace chert, buff and black, hard to very hard.
9570 - 9580	Shale, 100% as above.
9580 - 9620	Shale, 100% as above becoming very silty in part. Increase in dark gray shale.
9620 - 9640	Shale, 100% predominantly as above, light medium and dark gray shale in equal proportions. Dark gray shale more silty than lighter gray shale and more veined with calcite.
9640 - 9690	Shale, 100%, light to dark gray, predominantly medium gray, firm to medium hard, blocky to fissile, occasionally silty, non- to slightly calcareous, micromicaceous. Occasionally marly and clayey in part.
9690 - 9710	Shale, 80% as above. Claystone, 20%, white to light gray, light tan, moderately firm, blocky, moderately calcareous, silty grading to siltstone in part. Siltstone, moderate to very calcareous.
9710 - 9740	Shale, 100% as above. Claystone, 10% as above.

9740 - 9790	Shale, 100%, light to dark grey, firm to moderately hard, blocky to fissile, occasionally silty, non to slightly calcareous, micromicaceous in part, occasionally finely disseminated pyrite, some minor calcite veining. Trace claystone, white to light gray, moderately firm, blocky, moderately calcareous, marly,silty grading to siltstone.
9790 - 9810	Shale, 100%, predominantly medium gray, occasionally light gray, hard, occasionally very hard, blocky, non to moderately calcareous, micromicaceous, occasionally coarse mica, very silty. Trace claystone, as above.
9810 - 9840	Shale, 100%, light to dark gray, black, hard, blocky, often silty, non to moderately calcareous, micromicaceous. Trace marl, light gray brown, firm,very silty, very calcareous. Trace limestone, brown, hard, cherty.
9840 - 9870	Shale, 90%, light to medium gray, occasionally dark gray, firm to moderately hard, non to slightly calcareous, fissile, occasionally subfissile to blocky, silty in part, micromicaceous, occasionally grading to marl/ claystone, light gray occasionally light gray brown, firm, silty in part, slight to very calcareous. Trace limestone, as above. Trace pyrite and calcite.
9870 - 9920	Shale, 100%, becoming dark gray to black, dark brown gray, occasionally light to medium gray, moderately hard, blocky to subfissile, micromicaceous, becoming more silty, non to slightly calcareous, occasional calcite veining, fine disseminated pyrite and coarse black mica. Density around 2.60 grams/cc. Trace pyrite, limestone and claystone, as above.
9920 - 9960	Shale, 100%, as above, becoming predominantly medium to dark gray, often very silty.
9960 - 9970	Shale, 100%, light to medium gray, occasionally dark gray to black, firm to moderately hard, non to slightly calcareous, fissile, occasionally marly, silty and clayey. Trace of claystone/marl, brown to gray, firm, predominantly blocky, calcareous.
9970 - 10030	Shale, 70-90%, as above, becoming slightly more calcareous, more silty, marly with some loose pyrite, calcite, and minor veining. Siltstone, 0-20%, gray to brown, predominantly firm to soft, occasionally moderately hard, very calcareous grading to limestone, occasionally shaly grades to shale in part. Claystone/ marl, 0-10%, as above. Trace limestone, gray brown, very silty, micro to cryptocrystalline, hard, blocky.

10030 - 10090	Shale, 70-90%, as above. Marl/claystone, 10-20%, as above. Limestone, 0-5%, as above. Siltstone, 0-5%, as above.
10090 - 10170	Shale, 60-95%, medium to light gray, occasionally dark gray to black, fissile, occasionally subfissile, firm to moderately hard, very silty, non to slightly calcareous, subdolomitic with loose calcite and pyrite. Some fine disseminated pyrite with pyrite veining occasionally. Claystone/marl, 5-30%, gray brown, firm, blocky, silty, calcareous. Limestone, 0-10% dark gray to black, hard, blocky, microcrystalline. Some brown cryptocrystalline to microcrystalline fragments.
10170 - 10190	Shale, 90%, medium to dark gray, medium hard to hard, fissile, occasionally subfissile, micromicaceous, non to slightly calcareous, some dolomitic with trace of fine disseminated and very thin pyrite. Limestone, 5%, dark gray to black, hard, brittle, blocky, occasionally shaly and subfissile, slightly dolomitic. Marl, 5%, brown to gray, firm, silty in part, grading to claystone.
10190 - 10310	Shale, 95-100%, as above, becoming dark to brown gray, hard, this change occurring at 10,290'. Limestone, 0-5%, and marl, as above.
10310 - 10340	Shale, 100%, predominantly medium to dark gay, occasionally light gray, moderately hard to hard, fissile, occasionally subfissile, non to slightly calcareous, micromicaceous.
10340 - 10360	Shale, 90%, as above, becoming silty, slightly to moderately calcareous, occasionally grading to siltstone. Siltstone, 10%, dark brown, moderately calcareous, hard to moderately hard, argilllaceous, subfissile, blocky, grading to shale. Trace limestone, medium brown, hard, microcrystalline, slightly dolomitic, sucrose texture in part, tight.
10360 - 10370	Shale, 100%, as above.
10370 - 10380	Shale, 95%, as above. Limestone, 5%, black, hard to very hard, microcrystalline, blocky, dense.
10380 - 10400	Shale, 100%, predominantly dark gray to black, some light to medium gray, hard, micromicaceous in part, silty in part, non to slightly calcareous, with trace of fine disseminated pyrite, some loose pyrite, trace loose calcite.
10400 - 10410	Shale, 50%, light to medium gray, hard, fissile to

	subfissile, non calcareous, micromicaceous, slightly silty in part. Chert, 50%, dark gray brown to brown-black, very hard, splintery to blocky, brittle in part, dense, very silty in part, occasionally grading to siliceous siltstone.
10410 - 10430	Chert, 80%, as above. Shale, 20%, as above.
10430 - 10460	Chert, 95%, as above. Shale, 5%, as above.
10460 - 10560	Chert, 80-100%, as above, dark brown gray, silty. Shale, 0-10%, generally as above, some gray-brown, predominantly medium gray, non to slightly calcareous, fissile, moderately hard to hard, with loose pyrite and loose calcite and occasionally very thin calcite veining. Limestone, 0-10%, black, microcrystalline, hard, blocky, slightly silty, with loose calcite.
10560 - 10600	Chert, 90%, as above, becoming more shaly towards the base. Shale, 10%, as above.
10600 - 10610	Chert, 90%, dark gray to black, occasionally brown-gray black, very hard, blocky, brittle, splintery, very silty, opaque, shaly in part. Shale, 10%, light to medium gray, non to slightly calcareous, silty, micromicaceous, with loose pyrite and occasionally fine disseminated pyrite.
10610 - 10620	Chert, 60%, as above, with some fine disseminated pyrite. Shale, 30%, generally as above, some dark gray. Siltstone, 10%, dark gray to black, hard, blocky, noncalcareous, sandy with abundant white mica and disseminated pyrite.
10620 - 10650	Shale, 60-70%, as above. Chert, 30-40%, as above. Siltstone, trace 10%, as above.
10650 - 10670	Shale, 70-90%, as above. Claystone/marl, trace to 20%, light gray to white gray, firm,very argillaceous, very calcareous, occasionally silty. Chert, 10%, as above.
10670 - 10690	Shale, 70-80%, medium to dark gray, moderately hard to hard, fissile, occasionally subfissile, non-calcareous, silty in part. Claystone, 10-20%, light gray, moderately hard, blocky to subfissile, non-calcareous. Chert, 10%, dark gray, blocky, hard, occasionally splintery, silty in part.
10690 - 10780	Shale, 90-100%, as above, becoming very silty and marly towards the base with fine disseminated pyrite

	and occasionally very thin calcite veining. Claystone, 0-10%, as above, occasionally marly and very calcareous. Trace limestone, dark gray, microcrystalline, blocky, hard to very hard, cherty in part, silty in part.
10780 - 10790	Shale, 90%, medium to dark gray, moderately hard to hard, fissile, occasionally subfissile, predominantly noncalcareous, occasionally slight calcareous, micromicaceous in part with trace of disseminated pyrite. Limestone, 10%, black to dark gray, hard, brittle, blocky, shaly in part, microcrystalline in part.
10790 - 10800	Shale, 70%, as above. Claystone, 30%, light to medium gray, firm to moderately hard, blocky, non to slightly calcareous.
10800 - 10810	Shale, 100%, as above with occasionally pyrite veining. Trace limestone, brown to black, hard, sucrosic, blocky, dolomitic in part.
10810 - 10820	Shale, 90%, as above. Claystone, 10%, as above becoming more calcareous and grading to marlstone.
10810 - 10850	Shale, 100%, marly and clayey in part.
10850 - 10860	Shale,80%, dark brown gray, hard to moderately hard, fissle, noncalcareous with occasional finely disseminated pyrite. Claystone, 20%, light gray, firm, noncalcareous.
10860 - 10880	Shale, 100%, dark gray, occasionally dark brown gray to black as above, occasionally very slightly dolomitic, micromicaceous in part, with micaceous sheen, some fine disseminated pyrite, some minor pyrite and quartz veining, becoming siliceous.
10880 - 10890	Shale, 100%, as above, firm to moderately hard, siliceous in part becoming cherty. Trace chert, dark gray, hard to very hard, brittle in part, splintery in part, predominantly blocky. Some shaly and silty grading to shale with occasional thin calcite veining. Trace dolomite, dark gray black, microcrystalline, moderately hard, argillaceous in part, siliceous in part.
10890 - 10900	Shale, 90%, as above, predominantly dark brown gray to black, hard, siliceous. Chert, 10%, as above. Trace dolomite.
10900 - 10910	Shale, 80%, as above, becoming more clayey. Claystone, 20%, as above, some slightly dolomitic. Trace dolomite and chert.

10910 - 10920	Shale, 95%, dark gray-black, firm to hard, non-calcareous,fissile, very siliceous, some micro-micaceous with occasional finely disseminated pyrite. Claystone, 5%, light to medium gray, firm to mode-rately hard, noncalcareous.
10920 - 10970	Shale, 40-80%, as above, occasionally slightly dolomitic and slightly silty in part with calcite and quartz veining in the basal 20' predominantly thin, single, multiple and crossbanded evident. Chert, 20-50%, dark brown gray to black, hard to very hard, brittle, predominantly blocky, occasional conchoidal fracturing, some splintery with fine disseminated pyrite, shaly and silty in part. At 10,940'-10,950', 10% dolo-mite, dark gray, microcrystalline, hard, blocky, silty in part with some quartz.
10970 - 10980	Shale, 80%, dark gray, occasionally black, moderately hard, very siliceous in part, predominantly noncalcareous, occasionally slightly dolomitic, fissile with some calcite and quartz veining and fine disseminated pyrite. Chert, 20%, brown-gray, very hard, splintery, brittle with fine disseminated pyrite, impure, silty in part grading to siliceous shale/claystone.
10980 - 11020	Shale, 90%, as above, micromicaceous, slatey in part. Chert, 10%, as above, with some minor veining.
11020 - 11030	Shale, 90%, as above. Limestone, 10%, brown-gray, blocky, very silty grading to calcareous siltstone, Microcrystalline, dolomitic in part with occasional fine disseminated pyrite.
11030 - 11070	Shale, 80-95%, medium gray, fissile micromicaceous, noncalcareous, occasionally siliceous. Limestone, 5-20%, medium gray, argillaceous, silty, blocky, sucrosic with occasional calcite veining, dolomitic in part. Traces of chert.
11070 - 11090	Shale, 65-80%, as above. Limestone, 20-35%, as above becoming more dolomitic.
11090 - 11110	Shale, 40-50%, gray brown, predominantly gray, firm to moderately hard, fissile, noncalcareous, some silty and some micromicaceous. Dolomitic limestone, 50-60%, gray-white microcrystalline, moderately hard, silty, argillaceous, blocky, occasionally with pyrite. Traces of chert, sand and claystone.
11110 - 11130	Shale, 70-75%, as above. Dolomitic limestone, 25-30%, as above, with microcrystalline calcite fractures, and medium to thin veining.

11130 - 11140	Shale, 90%, gray, firm fissile, noncalcareous, slightly dolomitic. Claystone, 10%, light gray, slightly dolomitic, firm, subfissile, hygrofissile(?).
11140 - 11180	Shale, 100%, medium gray, fissile, firm, moderately Hard, noncalcareous, micromicaceous.
11180 - 11200	Shale, 90%, as above. Chert, 5%,black, hard, splintery to blocky fracture, dull with rare accessory pyrite.
11200 - 11230	Shale, 90%, as above. Limestone, 5%, light to medium gray, microcrystalline, hard, granular, blocky fracture, with rare finely disseminated pyrite. Dolomite, 5%, dark gray to black, hard, microcrystalline, granular, silty in part.
11230 - 11280	Shale, 90%, medium gray, fissile, moderately hard, micromicaceous and noncalcareous. Limestone, 10% and dolomite, medium to dark gray, microcrystalline, granular, blocky with blocky fractures, occasionally silty with trace of pyrite.
11280 - 11330	Shale, 9%, medium gray, fissile, moderately hard, siliceous, noncalcareous. Limestone, 5% and dolomite, medium to dark gray, microcrystalline, granular with blocky fracture, and minor pyrite.
11330 - 11390	Shale, 100%, dark brown to black, moderately hard, subfissile to fissile, carbonaceous, noncalcareous, with abundant accessory pyrite, occasionally silty in part and trace of limestone.
11390 - 11440	Shale, 100%, dark gray to black, moderately hard, fissile to subfissile, slightly to moderately micro-micaceous, noncalcareous, dull with minor disseminated pyrite, becoming slightly dolomitic.
11440 - 11520	Shale, 100%, dark gray to black, moderately hard, silty in part, carbonaceous, slightly dolomitic, subfissile with massive and finely disseminated pyrite common.
11520 - 11550	Shale, 100%, dark gray to black, hard becoming brittle, blocky, subconchoidal fracture, siliceous to carbonaceous, slightly micromiceous with good trace of pyrite.
11550 - 11560	Limestone, 25%, black, moderately hard to hard, brittle, blocky, microcrystalline, silty in part, slightly dolomitic. Shale, 75%, as above.
11560 - 11620	Shale, 100%, as above with trace of limestone and dolomite.

11620 - 11640	Chert, 60%, black, very hard, dense, dull, conchoidal to subconchoidal fracture with a trace of pyrite and calcite inclusions. Dolomite, 20%, light to medium gray, microcrystalline, hard with blocky fracture. Shale, 20%, as above.
11640 - 11654	Chert, 10%, as above. Dolomite, 90%, as above, medium-grained with intraclasts, angular and occasionally with dolomitic veins with abundant pyrobitumen making up to 25% of the sample. Intercrystalline and occasionally vuggy porosity filled by pyrobitumen which is black, hard, amorphous, vitreous with conchoidal fracture. Trace loose quartz which consists of clear angular grains. Top Nahanni dolomite - 11,640'.
11654 - 11690	Dolomite, 60%, medium to dark gray, fine to very fine crystalline. Dolomite, 30%, white, fine to medium crystalline, vug-filling and fossil-replacement dolomite as irregular patches in dark and medium gray dolomite. 10%, clear quartz infill which was deposited after the white dolomite vug-filling. Trace sphalerite, brown, resinous, lustrous, deposited after the quartz and before formation of the carbons. If no bitumen were present, porosity would be described as fair crystalline and vuggy. Bitumens, 5-15% (98-99% carbons) present.
11690 - 11750	Dolomite, see description for Core #2.
11750 - 11780	Dolomite, 50%, medium to dark gray, micro to fine crystalline, 20-30%, white, medium to coarse crystalline as breccia matrix and fracture filling, 10-20% clear authigenic quartz, sphalerite, bitumen, probable poor to fair vuggy porosity.
11780 - 12040	Dolomite, as above, no sphalerite, gradual downsection decrease in authigenic quartz.
12040 - 12064	Dolomite, see description for Core #3.
12064 - 12260	Dolomite, dark gray, fine to medium crystalline in bituminous microcrystalline matrix as in Core #3. White dolomite, 20%, microfractures between 12150-12170', calcareous matrix between 12180-12230'.
12260 - 12320	Dolomite, see description for Core #4.
12320 - 12450	Dolomite, medium to dark gray, very fine crystalline, slightly bituminous, 20% white, medium to coarse crystalline, no matrix porosity, interpreted poor vuggy porosity, white dolomite is 30% of 12,340' sample, 50% between 12360-80', 30% below 12380'; below 12320' is 10% limemud matrix, authigenic quartz above 12400' trace bitumen throughout.

12450 - 12510	Dolomite, see description for Core #5.
12510 - 12708	Dolomite, 50-70% dark gray bituminous, micro to fine crystalline, trace 50% medium gray microcrystalline mosaic, 10-30% white coarse crystalline, in part fractured, partly tight, partly with vuggy and fracture porosity, trace bitumen.
12708 - 12755	Dolomite, see description for Core #6.
12755 - 12789	Dolomite, see description for Core #7.
12789	TOTAL DEPTH

DRILL STEM TESTS

DRILL STEM TEST #1

Interval: 7725' - 7921 1.34 MMcfd
Gas to surface - 6 minutes 20' flare
Final shut-in pressure - 2894 psi
Bottom hole temperature - 167°F

DRILL STEM TEST #2

Interval: 11630' - 11690' 1.8 MMcfd
Using 3500' water cushion
Initial hydrostatic pressure - 5976 psi, preflow 1619 psi,
Initial shut-in pressure - 5680 psi
Initial flowing pressure - 1748 psi
Final flowing pressure - 659 psi
Final shut-in pressure - 5680 psi
Final hydrostatic pressure - 5976 psi

DRILL STEM TEST #3

Interval: 11680' - 11890' Misrun
Using 2500' water cushion
Fair blow on preflow
1 hour shut-in
Lost seat

DRILL STEM TEST #4

Interval: 11695' - 11890' Misrun
Using 3500' water cushion
No seat

DRILL STEM TEST #5

Interval: 11695' - 11890'
Gas to surface - 45 minutes
Initial hydrostatic pressure - 5886 psi
Preflow 1665 psi
Initial shut-in pressure - 5608 psi
Initial flowing pressure - 1831 psi
Final flowing pressure - 906 psi
Final shut-in pressure - 5608 psi
Final hydrostatic pressure - 5850 psi
Flow characteristics: 50 minutes - 8.5 MMcfd
60 minutes - 8 MMcfd
70 minutes - 7.2 MMcfd
80 minutes - 6.4 MMcfd
90 minutes - 3.8 MMcfd
100 minutes - 3.8 MMcfd

6.03

SECTION III

Engineering Summary

D&S PETROLEUM CONSULTANTS LTD.

DRILL STEM TEST REPORT

73F 5

DST No. 1

Well COLUMBIA ET AL KOTANEELEE YT H38 Date August 10, 1977

Test Interval 7725 - 7920 Formation Mississippian

Testing Co. Johnston Type of Test Bottom Hole

Hole Size 12 1/4" Packer Size 11 1/2" Choke Size 1/2"

Auxiliary Equipment Safety joint, MFE Tool, Pump Out Sub, Surface Manifold

Time Record

Preflow 10 mins (1) ISI 30 (1) VO 64 mins (2) SI 128 mins

(2) VO _____ mins (3) FSI _____ mins

Gas Measurement

Preflow Description Strong initial puff, gas to surface in 6 minutes of preflow.

Blow Description Fair gas blow increasing to good in 10 minutes. Unloading mud in 25 minutes of flow period.

30 minutes - 1" choke, 50psi 1360 mcf

59 minutes - 1/8" choke, 31 psi 740 mcf unloading mud

Measured With _____

Fluid Recovery

Total Fluid 1350 ft Mud gas cut

Oil _____ Water _____

No. of samples _____ From _____

Samples Sent To _____

Pressure Readings

IHP 4008 (1) ISIP 3368 (1) FP 739 to 673 (2) SIP 2918

(2) FP _____ to _____ (3) FSIP 2918 FHP _____ BHT 186 °F

Remarks Test satisfactory

John Dortch

Witness Field Supervisor

D&S PETROLEUM CONSULTANTS LTD.

DRILL STEM TEST REPORT

73F5

DST No. 2

Well COLUMBIA ET AL KOTANEELEE YT H38 Date Sept 28/77

Test Interval 11,630'-11,690' Formation NaHanni

Testing Co. Johnston Type of Test Dual Packers - Bottom Hole

Hole Size 8 1/2" Packer Size 8" Choke Size 1/2"

Auxiliary Equipment Jars, pump and sub, safety joint, surface manifold with Willis choke, MFE valve, 3500' water cushion.

Time Record

Preflow 10 mins (1) ISI 60 (1) VO 120 mins (2) SI 240 mins

(2) VO ____ mins (3) FSI ____ mins

Gas Measurement

Preflow Description weak air blow on preflow

Blow Description water cushion and gas to surface in 30 minutes

60 mins - 1" choke - 180 psig - 5.09 MMcf/d

70 mins - 1" - 170 - 4.70 MMcf/d. 110 min - 3/4" ; 160 - 2.45 MMcf/d

80 mins - 3/4" 170 - 3.00 MMcf/d. 120 min - 3/4" ; 150 - 2.30 MMcf/d

Measured With surface choke and pressure gauge

Fluid Recovery

Total Fluid 750' gas cut water cushion Mud ____

Oil ____ Water 750'

No. of samples ____ From ____

Samples Sent To ____

Pressure Readings 1619 preflow

IHP 5976 (1) ISIP 5608 (1) FP 1748 to 659 (2) SIP ____

(2) FP ____ to ____ (3) FSIP 5680 FHP 5976 BHT 250 °F

Remarks test successful

JOHN DORTCH

Witness Field Supervisor

D&S PETROLEUM CONSULTANTS LTD.

DRILL STEM TEST REPORT

73F 5

DST No. 3

Well COLUMBIA ET AL KOTANEELEE YT H38 Date October 2, 1977

Test Interval 11680-11890 Formation Nahanni

Testing Co. Johnston Type of Test Bottom Hole

Hole Size 8 1/2 Packer Size 7 1/2 Choke Size

Auxiliary Equipment Safety joint, MFE Tool, Pump Out Sub, Surf. Manifold

Time Record

Preflow 10 mins (1) ISI 60 (1) VO mins (2) SI 60 mins

(2) VO mins (3) FSI mins

Gas Measurement

Preflow Description Fair initial puff increasing to good.

Blow Description Gas to surface in 45 minutes of initial shut in. No packer seat on valve open. Strong air spray for 2 hours after shut in.

Reversed out test

Measured With

Fluid Recovery

Total Fluid Mud

Oil Water

No. of samples From

Samples Sent To

Pressure Readings Preflow 1603

IHP 5940 (1) ISIP 5659 (1) FP 2096 to 2549 (2) SIP

(2) FP to (3) FSIP 5657 FHP 6144 BHT 297 ° F

Remarks Misrun, packer leaking

John Dortch

Witness Field Supervisor

D&S PETROLEUM CONSULTANTS LTD.

DRILL STEM TEST REPORT

73F 5

DST No. 4

Well COLUMBIA ET AL KOTANEELEE YT H38 Date Oct 3/77

Test Interval 11695 - 11890 Formation Nahanni

Testing Co. Johnston Type of Test Bottom Hole

Hole Size 8 1/2 " Packer Size 7 1/2" Choke Size 1/2"

Auxiliary Equipment SAfety joint, MFE Tool, Pump Out Sub, Surface Manifold

Time Record

Preflow 5 mins (1) ISI 60 (1) VO _____ mins (2) SI _____ mins

(2) VO _____ mins (3) FSI _____ mins

Gas Measurement

Preflow Description Gas to surface 15 minutes after second flow

Blow Description _____

Measured With _____

Fluid Recovery

Total Fluid 4200 Mud 700'

Oil _____ Water 3500' cushion

No. of samples _____ From _____

Samples Sent To _____

Pressure Readings preflow 2360

IHP 5873 (1) ISIP 5622 (1) FP 2733 to 2829 (2) SIP _____

(2) FP _____ to _____ (3) FSIP _____ FHP 5893 BHT 307 °F

Remarks Misrun. Lost packer seat.

John Dortch

Witness Field Supervisor

D&S PETROLEUM CONSULTANTS LTD.

DRILL STEM TEST REPORT

73F 5

DST No. 5

Well COLUMBIA ET AL KOTANEELEE YT H38 Date October 5, 1977

Test Interval 11,620'-11,890' Formation Nahanni

Testing Co. Johnston Type of Test Bottom Hole - 3 packers

Hole Size 8 1/2" Packer Size 6 5/8" Choke Size 1/2"

Auxiliary Equipment safety joint, jars, MFE tool, pump out sub, surface manifold

Time Record

Preflow 10 mins (1) ISI 60 (1) VO 120 mins (2) SI 240 mins

(2) VO ____ mins (3) FSI ____ mins

Gas Measurement

Preflow Description Fair air blow, gas to surface in 45 mins. of initial shut in.

Blow Description Good blow, water and gas in 10 minutes

50 min -	1" choke -	380 psig -	10.0 MM wet gas	80 min -	1" choke -	280 psig -	7.6 MM (drying up)
60 "	1"	350	9.4	90 to 120 -	3/4"	320	4.7
70 "		320	8.6	with muddy water mist at end			

Measured With ____

Fluid Recovery

Total Fluid 800' of muddy water cushion Mud ____

Oil ____ Water 800'

No. of samples ____ From ____

Samples Sent To ____

Pressure Readings preflo 1665

IHP 5886 (1) ISIP 5608 (1) FP 1831 to 906 (2) SIP ____

(2) FP ____ to ____ (3) FSIP 5608 FHP 5850 BHT 286 ° F

Remarks test satisfactory

John Dortch

Witness Field Supervisor

JOHNSTON TESTERS

A DIVISION OF SCHLUMBERGER CANADA LIMITED
321 - 50th AVENUE S.E. CALGARY, ALBERTA T2G 2B3

District	Fort St. John	Ticket No. E15042	Company: Columbia Gas Development of Canada Ltd.
Address	c/o D & S Consultants, 550 - 6 Avenue S.W.		Test No. 1 J.T. No. 1
	Calgary, Alberta T2P 0S2	Well Name	Columbia Gas Cotoneely
Field	Cotoneely	Number	YT H-38
Province	British Columbia	Date	August 10, 1977
Co. Rep.		Formation	Thickness
Technician	T. Thompson	Interval	7725 - 7920' TD 7921'

TEST DATA

Type of Test	Open hole, Bottom hole.				
Time Started in Hole	0330	Hrs.	Tool Opened	0828	Hrs.
First Flow	10	Min.	Initial Shut-In	30	Min.
Second Flow	64	Min.	Second Shut In	128	Min.
Third Flow		Min.	Final Shut In		Min.
Pulled Loose @	1330	Hrs.	Out of Hole	1900	Hrs.
Wt. Set/on Packers	30,000	#	Pulled Loose Wt.		#

Description of Blow During Test: Strong initial puff with gas to surface in 6 minutes on preflow. Fair gas blow on valve opening increasing to good in 10 minutes, began unloading mud in 25 minutes of flow period.

FLUID RECOVERY Was Test Reverse Circulated Yes ☐ No ☒

Total Fluid Recovered 1,350 Ft.

Description of Fluid Recovered

1,350' Gas cut, drilling fluid.

GAS BLOW MEASUREMENT

Measured With Critical Flow Prover Gauge 2" I.D. Riser

Time	Sfce. Choke	Reading psi	M Cubic Feet/Day
0918	1"	48	1300
0928	1"	52	1390
0938	1"	50	1360
Began unloading mud, choked back to 15 psi on gauge opened 4" valve to allow mud to escape.			
0948	1/8"	37	820
0958	1/8"	37	820
1009	1/8"	32	740
Still unloading mud.			

REMARKS: Test satisfactory.
Lost approximately 15' of mud on preflow.

RESISTIVITY			SALT CONTENT
Recovery Water	@	°F.	ppm.
Mud Pit sample filtrate	@	°F.	36,500 ppm.

TOOL SEQUENCE

Tool	Length	O.D.
P.O. Sub	1.00	
D.P. Sub	.65	
MFE Tool	9.30	
Bypass Tool	2.85	
Safety Joint	1.75	
S.S. & Packer	11.50	11 1/2"
T.C. & Packer	6.00	11 1/2"
Total	33.05	
Packer Stub	1.50	
Perfs	9.00	
Recorder	4.25	
Recorder	4.30	
Sub	2.50	
Drill Collars	172.54	
Sub	.75	
Bull Nose	1.50	
Total Interval	196.34	
TOTAL LENGTH		

Elevation G.L. 2250 K.B. 2275
Bottom Hole Choke Size 1/2"
Fluid Cushion Type Nil Amt.

MUD AND HOLE DATA

Mud Type Gel Chem W.L.
Filter Cake 4½/32" Visc. 40 Wt. 9.8
Time Taken 2400 hours
Contractor Nabors Drilling Rig No. 9
Drill Pipe Size 4 1/2" IF
Drill Collar Size 4 1/2" XH &
Drill Collar Length 406' &
Main Hole Size 12 1/4" Rat Hole

Distribution of Reports 10 - Calgary Attention: Mr. L. Kerkoff

JOHNSTON 1

Schlumberger

JOHNSTON TESTERS

A DIVISION OF SCHLUMBERGER CANADA LIMITED

321 - 50th AVENUE S.E. CALGARY, ALBERTA T2G 2B3

E15042

PRESSURE DATA

INSTRUMENT No.		AK1-2100	AK1-4367			
CAPACITY (psig)		7000	7000			
INSTRUMENT DEPTH FT.		7736	7740			
INSTRUMENT OPENING		Outside	Outside			
WELL TEMP. °F.	186					
INITIAL HYDROSTATIC	A	3994#	4008#			
FIRST FLOW	B	Unreadable	Unreadable			
	B-1	Unreadable	1549#			
INITIAL SHUT-IN	C	3361#	3368#			
SECOND FLOW	D	737#	739#			
	D-1	667#	673#			
SECOND SHUT-IN	E					
THIRD FLOW	F					
	F-1					
FINAL SHUT-IN	G	2912#	2918#			
FINAL HYDROSTATIC	H	3847#	Unreadable			

FLUID SAMPLE REPORT

Sample No.	521
Type	5"
Depth	7703'
Volume	2500 cc
Sample Pressure:	psig. at Surface
Gravity	API @ °F
Gas/Oil Ratio	Cu.Ft./bbl.
Recovery:	
Cu. Ft. Gas	
cc. Oil	
cc. Water	
cc. Mud	
Total Liquid cc.	

REMARKS: MFE sample #521 and fluid sample #6395 was sent to Core Labs., in Calgary, Alberta.

PRESSURE INCREMENTS ON RECORDER

POINT MINUTES	PRESSURE	$\frac{T + \Delta t}{\Delta t}$	POINT MINUTES	PRESSURE	$\frac{T + \Delta t}{\Delta t}$	POINT MINUTES	PRESSURE	$\frac{T + \Delta t}{\Delta t}$

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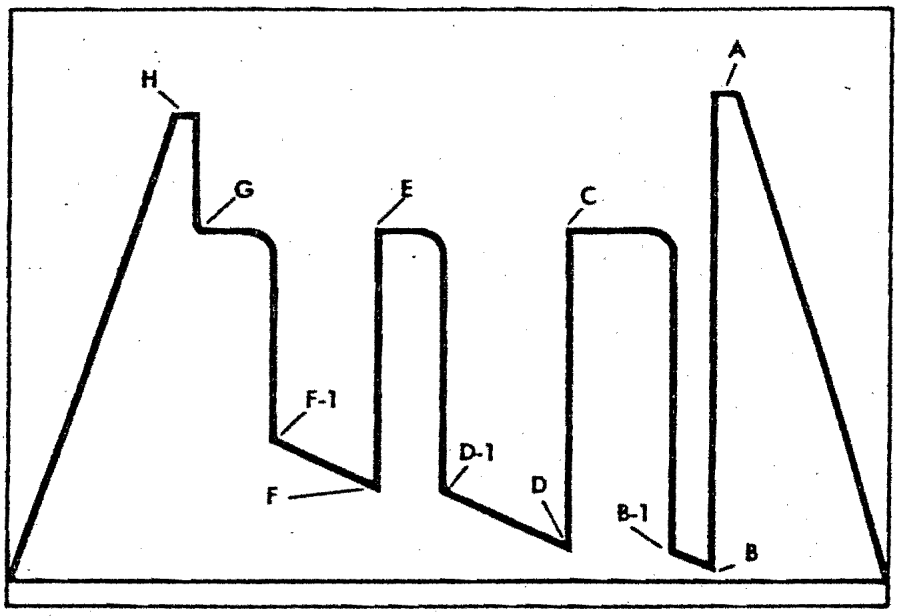
GUIDE TO IDENTIFICATION OF DRILL STEM TEST PRESSURE CHARTS

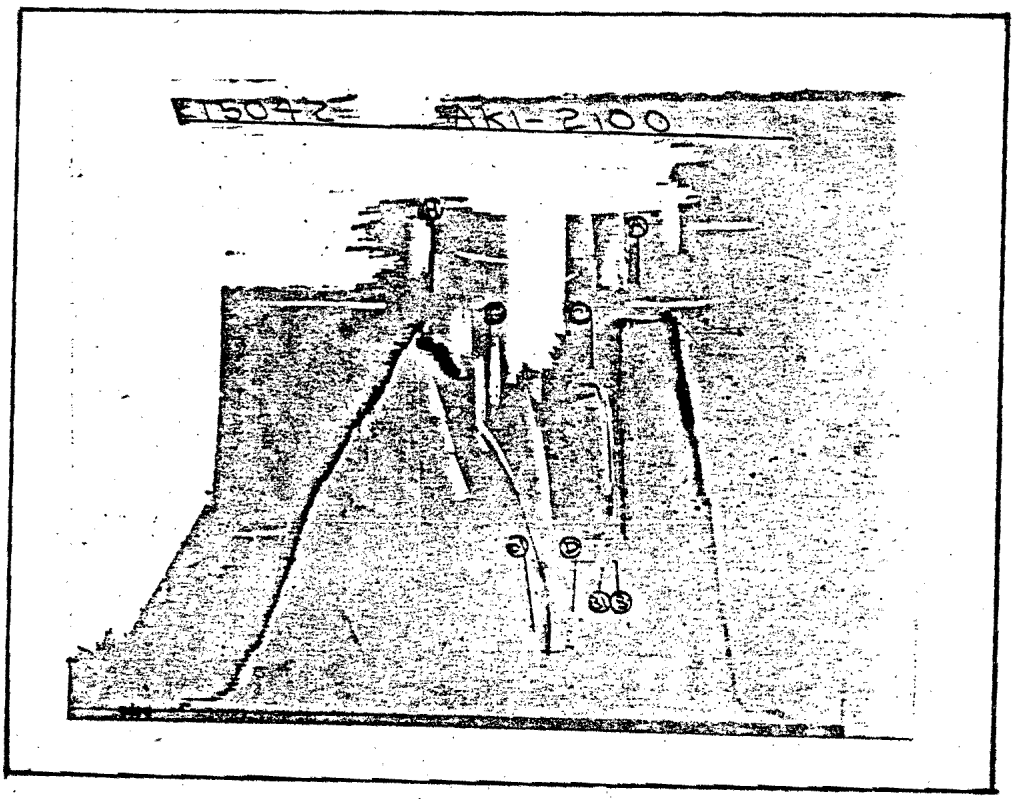
FIELD REPORT NO.	RECORDER NO.
E15042	AK1-2100



A. Initial Hyd. Mud
B. First Flow
C. Initial Shut-In
D. Second Flow
E. Second Shut-In
F. Third Flow
G. Final Shut-In
H. Final Hyd. Mud

The following points are either fluctuating pressures or points indicating other packer settings (testing different zones).

A-1, A-2, A-3, etc. Initial Hyd. Pressures
Z — Special pressure points such as pumping pressures recorded for formation breakdown.



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DRILL STEM TEST SPECIAL DATA ANALYSIS

Columbia Gas Limited DST #2
Columbia Gas et al Kotaneelee E15085
11,630 - 11,690' 11,690'
September 28, 1977

October 4, 1977

ATTENTION: RICK SMITH

Gentlemen:

The enclosed test appears to be a good mechanical drill stem test during which the tools functioned properly, and the formation produced enough reservoir fluid for proper identification. Reservoir pressure drawdown was sufficient and adequate shut-in build-ups occurred for reliable quantitative analysis.

1. Flow Rate: A flow rate of ~~1824~~ 2,300 MCF/day of gas was noted during this test.

2. Reservoir Pressure: Mechanical Stabilization of the inital shut-in pressure build-up indicates a maximum reservoir pressure of 5689 psig at recorder depth. Mechanical stabilization of the final shut-in pressure build-up indicates a maximum reservoir pressure of 5691 psig at recorder depth.

3. Permeability: The calculated transmissibility factor of 4739 md.ft./cp. indicates an average effective permeability to gas of 2.37 md. for the reported 50 foot porous interval. The calculations were based on a slope of 505,000 psi^2/ log cycle obtained from the final shut-in build-up plot. It was assumed for these calculations: (A)gas gravity 0.70, (B)viscosity 0.025 cp., (C) and gas deviation factor 1.07. These figures were obtained from the available technical literature.

4. Well Bore Damage: The calculated estimated damage ratio of 12.32 indicates that high well bore damage is present at the time and conditions of this test. This value appears to be excessive and may be due to the partial penetration of the net production interval by the test interval. If subsequent information confirms this possibility then the value for D.R. should be discounted.

5. Radius of Investigation: The calculated radius of investigation of this test is 162.6 feet based on an assumed porosity of 7.5%, compressibility of 1.12×10^{-4} vol/vol/psi, and other assumptions made in number 3 above.

6. General Comments: The formation exhibits the characteristics of relatively low permeability effective to the reservoir fluid and well bore damage is indicated. No unusual characteristics were noted from the analysis of the test data presented. The main feature of this test is that an assumed horner plot slope was utilized to obtain reservoir calculations.

Yours truly,

Jose Cuesta
Technical Analyst

JC/jmh

WELL: COLUMBIA GAS ET AL KOTANEELEE DST #2

FLOW RATE PRIOR TO SHUT IN	(MCF/DAY)	1824.000
COMPRESSIBILITY FACTOR Z		1.0700
HORNER PLOT SLOPE	(PSI^2/LOG CYCLE)	505000.
VISCOSITY	(CP)	0.025
NET THICKNESS	(FT)	50.000
MAX RESERVOIR PRESSURE	(PSIG)	5691.0
FLOWING PRESSURE	(PSIG)	1672.0
FLOW TIME	(MIN)	135.0
POROSITY		0.075
COMPRESSIBILITY	(1/PSI)	0.00011200
WELL BORE RADIUS	(IN)	6.13
WELL ELEVATION	(FT)	2275.0
RECORDER DEPTH	(FT)	11650.0
TEMPERATURE	(DF)	289.0

TRANSMISSIBILITY	(MD-FT/CP)	4738.57
FLOW CAPACITY	(MD-FT)	118.46
AVERAGE EFF. PERMEABILITY	(MD)	2.37
DAMAGE RATIO		12.32
FLOW RATE WITH DAMAGE REMOVED	(MCF/DAY)	22471.092
POTENTIOMETRIC SURFACE	(FT)	3765.5
RADIUS OF INVESTIGATION	(FT)	162.6

USED 12.81 UNITS
PURGE PRESDAT
FILE NOT SAVED
READY
PURGE BLD2DATA

READY
BYE
00015.98 CRU 0000.05 TCH 0002.07 KC

OFF AT 13:49MDT 10/04/77

RESERVOIR PRESSURE PLOT

JOHNSTON
Schlumberger

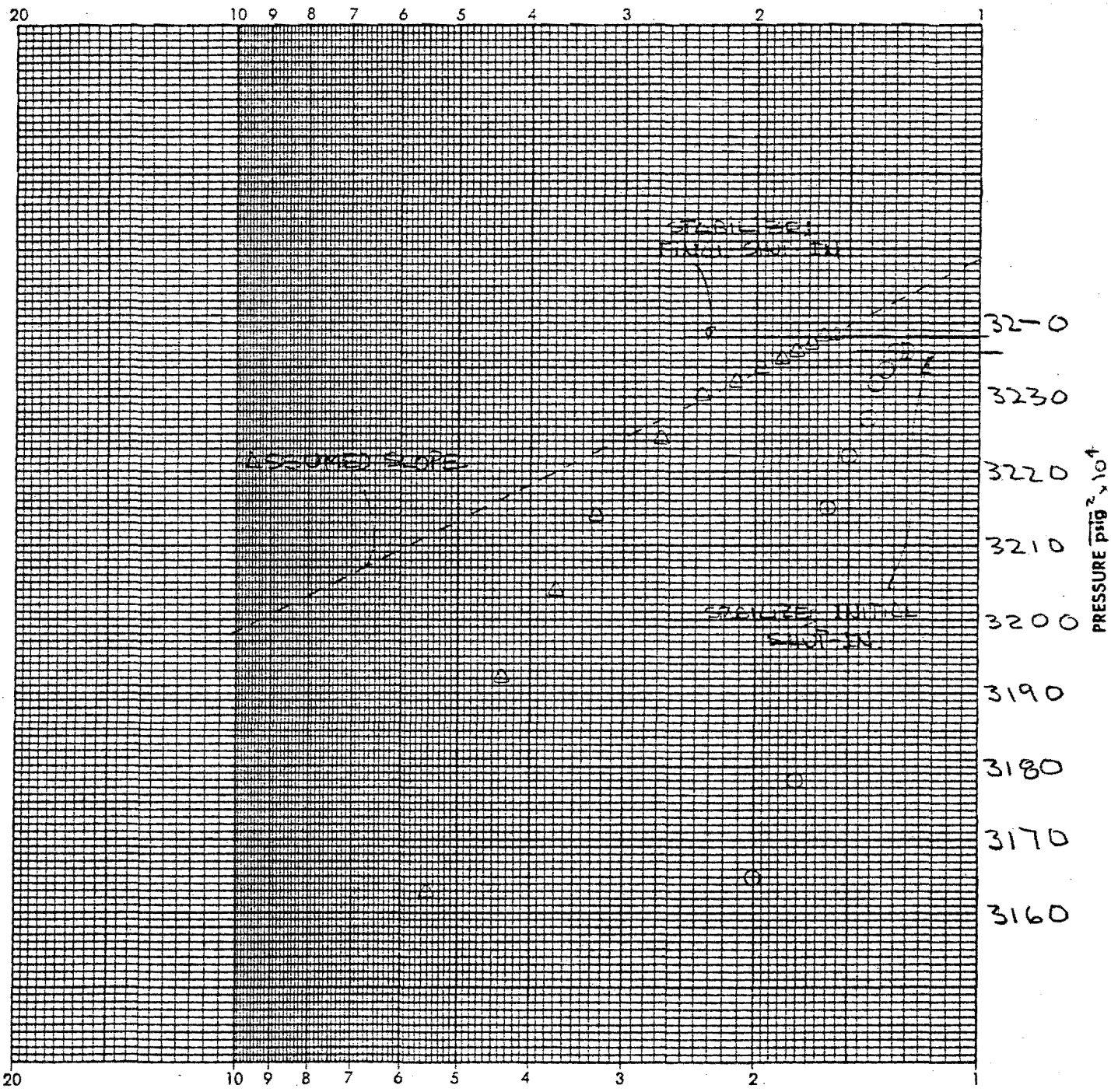
RECORDER No. AK 1 5023 CAPACITY 8650 FIELD REPORT No.

MAXIMUM RESERVOIR PRESSURE P_o = psig INITIAL SHUT-IN = 5689 PSIG

SLOPE OF SHUT-IN CURVE M 1 = psig/LOG CYCLE FINAL SHUT-IN = 5691 PSIG

SLOPE M 1 = P_1 3248.5 x 10^4 P_{10} 3198.0 x 10^4 = psig/LOG CYCLE 505000

SLOPE M 2 = P_1 P_{10} = psig/LOG CYCLE



$$\frac{T + \Delta t}{\Delta t}$$

JT-CD-2A

JOHNSTON TESTERS

A DIVISION OF SCHLUMBERGER CANADA LIMITED
321 - 50th AVENUE S.E. CALGARY, ALBERTA T2G 2B3

District	Calgary	Ticket No. E15085	Company: Columbia Gas Limited
Address	1420 Standard Life Building, 639 - 5 Avenue S.W.,	Test No. 2	J. T. No. 2
	Calgary, Alberta T2P 0M9	Well Name	Columbia Gas et al Kotaneelee
Field	Kotaneelee	Number	H-28-60-10-124
Province	Yukon Territory	Date	September 28, 1977
Co. Rep.	J. Dortch	Formation	Thickness
Technician	T. Thompson	Interval	11,630 - 11,690' TD 11,690'

TEST DATA

Type of Test	Open hole, Bottom hole.		
Time Started in Hole	0830 Hrs.	Tool Opened	1512 Hrs.
First Flow	15 Min.	Initial Shut-In	60 Min.
Second Flow	120 Min.	Second Shut In	240 Min.
Third Flow	Min.	Final Shut In	Min.
Pulled Loose @	2245 Hrs.	Out of Hole	0700 Hrs.
Wt. Set/on Packers	30,000 #	Pulled Loose Wt.	30,000 #

Description of Blow During Test: Fair initial aie puff on preflow. Fair air blow on final flow period with gas to surface in 25 minutes.

FLUID RECOVERY

Was Test Reverse Circulated Yes XX No ☐

Total Fluid Recovered: 755 Ft.

Description of Fluid Recovered: 755' Gasified water.

GAS BLOW MEASUREMENT

Measured With Critical Flow Prover Gauge. 2" I.D. Riser

Time	Sfce. Choke	Reading psi	M Cubic Feet/Day
1735	64	180	5090
1745	64	170	4700
1755	54	170	2580
1805	54	160	2450
1815	54	155	2390
1825	54	150	2300

REMARKS: Test satisfactory.

	RESISTIVITY		SALT CONTENT
Recovery Water	@	°F.	ppm.
Mud Pit sample filtrate	@	°F.	ppm.

TOOL SEQUENCE

Tool	Length	O.D.
P.O. Sub	1.00	
D.P. Sub	.65	
MFE Tool	12.55	
Bypass Tool	2.85	
Recorder	4.40	
Safety Joint	1.75	
S.S. & Packer	9.30	7 1/2"
T.C. & Packer	6.55	7 1/2"
Total	39.05	
Packer Stub	1.00	
Perfs	15.00	
Recorder	4.40	
Recorder	4.40	
Perf	3.00	
Sub	1.00	
Drill Collar	28.55	
Sub	1.00	
Packer Stub	2.00	
Total Interval	60.35	
TOTAL LENGTH		

Elevation G.L. 2250 K.B. 2275

Bottom Hole Choke Size. 1/2"

Fluid Cushion Type Water Amt. 3500'

MUD AND HOLE DATA

Mud Type KCL W.L.

Filter Cake 2/32 Visc. 70 Wt. 9,8

Time Taken 2400 hours

Contractor Nabours Drilling Rig No. 9

Drill Pipe Size 4 1/2" IF

Drill Collar Size 4 1/2" XH &

Drill Collar Length 605' &

Main Hole Size 12 1/4" Rat Hole

Distribution of Reports 12 - Calgary Attention: Rick Smith

JOHNSTON Schlumberger

JOHNSTON TESTERS

A DIVISION OF SCHLUMBERGER CANADA LIMITED
321 - 50th AVENUE S.E. CALGARY, ALBERTA T2G 2B3

E15085

PRESSURE DATA

INSTRUMENT No.		AK1-4371	AK1-2095	AK1-5025	T-5365
CAPACITY (psig)		7400	7450	8650	220 - 549 °F
INSTRUMENT DEPTH FT.		11608	11646	11650	11659
INSTRUMENT OPENING		Inside	Outside	Outside	Outside
WELL TEMP. °F.					
INITIAL HYDROSTATIC	A	5982#	6006#	6014#	
FIRST FLOW	B	1650#	1643#	1644#	
	B-1	1688#	1677#	1681#	
INITIAL SHUT-IN	C	5689#		5692#	
SECOND FLOW	D	1752#		1734#	
	D-1	650#		643#	
SECOND SHUT-IN	E		Clock		
THIRD FLOW	F		Stopped		
	F-1				
FINAL SHUT-IN	G	5689#		5692#	
FINAL HYDROSTATIC	H	5971#		6014#	

FLUID SAMPLE REPORT

Sample No.	103421 & 110267
Type	5"
Depth	11,593'
Volume	2500 cc
Sample Pressure:	psig. at Surface
Gravity	API @ °F
Gas/Oil Ratio	Cu.Ft./bbl.
Recovery:	
Cu. Ft. Gas	
cc. Oil	
cc. Water	
cc. Mud	
Total Liquid cc.	

REMARKS: Temperature recorder #5365 - 0.101 Defl. = 289 °F
MFE samples #103421 & #110267 and fluid sample #6445 sent to C & G Labs., Calgary, Alberta.

PRESSURE INCREMENTS ON RECORDER

Initial Shut-in

POINT MINUTES	PRESSURE	$\frac{T + \Delta t}{\Delta t}$
0	1679	-----
5	3947	4.000
10	5485	2.500
15	5626	2.000
20	5637	1.750
25	5670	1.600
30	5676	1.500
35	5681	1.428
40	5685	1.375
45	5687	1.333
50	5689	1.300
55	5689	1.273
60	5689	1.250

Final Shut-in

POINT MINUTES	PRESSURE	$\frac{T + \Delta t}{\Delta t}$
0	1672	------
10	5029	14.500
20	5546	7.750
30	5624	5.500
40	5650	4.375
50	5661	3.700
60	5670	3.250
80	5678	2.687
100	5683	2.350
120	5685	2.125
140	5687	1.964
160	5688	1.843
180	5689	1.750
200	5690	1.675
220	5691	1.614
240	5691	1.562

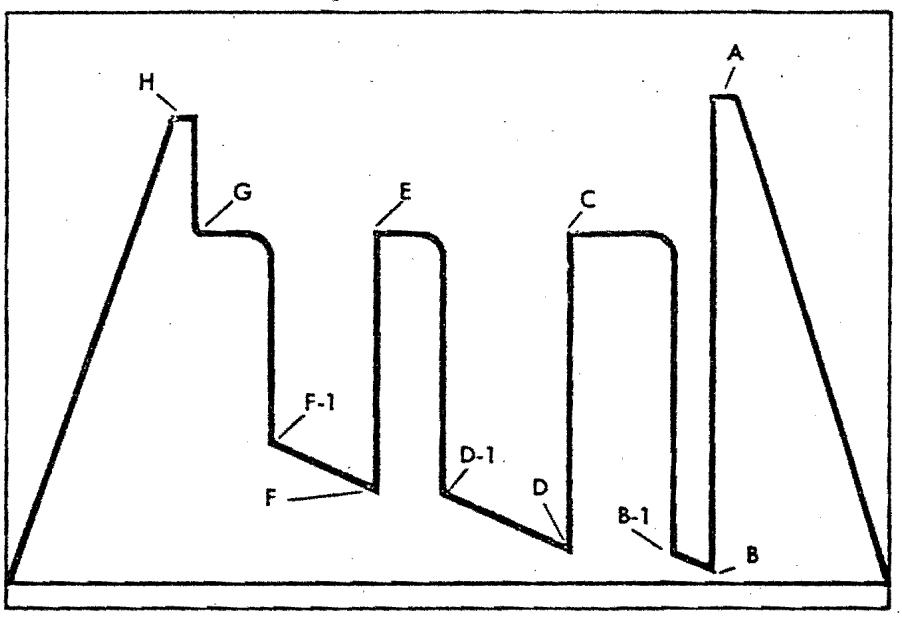
POINT MINUTES	PRESSURE	$\frac{T + \Delta t}{\Delta t}$

JTS-E-5B

JOHNSTON
321 - 50TH AVENUE S.E. • CALGARY, ALBERTA T2G 2B3 • PH. (403) 255-1151

GUIDE TO IDENTIFICATION OF DRILL STEM TEST PRESSURE CHARTS

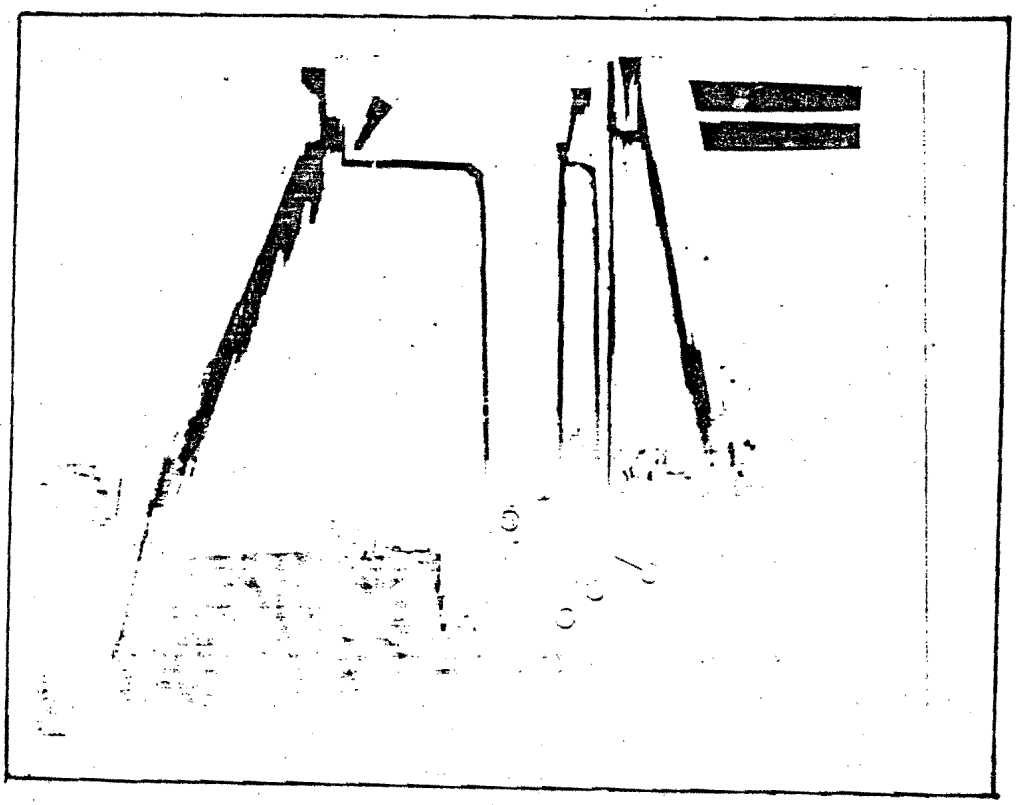
FIELD REPORT NO.	RECORDER NO.
E15085	AK1-4371



A. Initial Hyd. Mud
B. First Flow
C. Initial Shut-In
D. Second Flow
E. Second Shut-In
F. Third Flow
G. Final Shut-In
H. Final Hyd. Mud

The following points are either fluctuating pressures or points indicating other packer settings (testing different zones).

A-1, A-2, A-3, etc. Initial Hyd. Pressures
Z — Special pressure points such as pumping pressures recorded for formation breakdown.



JOHNSTON TESTERS

A DIVISION OF SCHLUMBERGER CANADA LIMITED
321 - 50th AVENUE S.E. CALGARY, ALBERTA T2G 2B3

District	Fort St. John	Ticket No.	E15086
Company	Columbia Gas Development Ltd.		
Address	c/o D & S Consultants, #600, 633 - 6 Avenue S.W., Calgary, Alberta T2P 0S2	Test No.	1(3)
J.T. No.	3		
Well Name	Columbia Gas et al Kotaneelee		
Field	Kotaneelee	Number	H-38-60-10-124
Province	Yukon Territory	Date	October 2, 1977
Co. Rep.	J. Dortch	Formation	Nahanni
Thickness			
Technician	T. Thompson	Interval	11,680 - 11,890'
TD	11,890'		

TEST DATA

Type of Test	Open hole, Bottom hole.				
Time Started in Hole	0300	Hrs.	Tool Opened	0840	Hrs.
First Flow	10	Min.	Initial Shut-In	60	Min.
Second Flow		Min.	Second Shut In	60	Min.
Third Flow		Min.	Final Shut In		Min.
Pulled Loose @	1115	Hrs.	Out of Hole	2400	Hrs.
Wt. Set/on Packers	30,000	#	Pulled Loose Wt.	30,000	#

Description of Blow During Test: Fair initial puff on pre-flow increasing to good. Gas to surface in 45 minutes of initial shut-in. No packer seat on value opening. Strong gas spray for 2 hours after shut-in.

FLUID RECOVERY Was Test Reverse Circulated Yes XX No ☐

Total Fluid Recovered: N/A Ft.

Description of Fluid Recovered: N/A' Water & drilling fluid.

GAS BLOW MEASUREMENT

Measured With: I.D. Riser

Time	Sfce. Choke		M Cubic Feet/Day
		NIL	

REMARKS: Misrun, packer was leaking.

RESISTIVITY			SALT CONTENT
Recovery Water	@	°F.	ppm.
Mud Pit sample filtrate	@	°F.	ppm.

TOOL SEQUENCE

Tool	Length	O.D.
P.O. Sub	1.00	
D.P. Sub	.65	
MFE Tool	12.55	
Bypass Tool	2.85	
Recorder	4.40	
Safety Joint	1.75	
S.S. & Packer	9.30	7 1/2"
T.C. & Packer	6.55	7 1/2"
Total	39.05	
Packer Stub	1.00	
Perfs	18.00	
Recorder	4.40	
Recorder	4.40	
Sub	1.20	
Drill Collars	177.55	
Sub	1.10	
Bull Nose & Perf	2.00	
Total Interval	209.65	
TOTAL LENGTH		

Elevation G.L. 2750 K.B. 2275

Bottom Hole Choke Size 1/2"

Fluid Cushion Type Nil Amt.

MUD AND HOLE DATA

Mud Type KCL W.L. 23.0

Filter Cake 2/32 Visc. 41 Wt. 9.9

Time Taken 1400 hours

Contractor Nabors Drilling Rig No. 9

Drill Pipe Size 4 1/2" IF

Drill Collar Size 4 1/2" XH &

Drill Collar Length 435' &

Main Hole Size 8 1/2" Rat Hole

Distribution of Reports: 12 - Calgary Attention: Mrs. Wiebe

3 JOHNSTON Schlumberger

JOHNSTON TESTERS

A DIVISION OF SCHLUMBERGER CANADA LIMITED
321 - 50th AVENUE S.E. CALGARY, ALBERTA T2G 2B3

E15086

PRESSURE DATA

INSTRUMENT No.		AK1-4371	AK1-2095	AK1-5025	T-5365
CAPACITY (psig)		7400	7450	8650	200-549 °F
INSTRUMENT DEPTH FT.		11658	11699	11703	11717
INSTRUMENT OPENING		Inside	Outside	Outside	Outside
WELL TEMP. °F.					
INITIAL HYDROSTATIC	A	5895#	5946#	5940#	
FIRST FLOW	B	1589#	1617#	1603#	
	B-1	1583#	1608#	1598#	
INITIAL SHUT-IN	C	5642#	5658#	5659#	
SECOND FLOW	D	2079#	2103#	2096#	
	D-1	2533#	2563#	2549#	
SECOND SHUT-IN	E				
THIRD FLOW	F				
	F-1				
FINAL SHUT-IN	G	5642#	5657#	5657#	
FINAL HYDROSTATIC	H	6126#	6148#	6144#	

FLUID SAMPLE REPORT

Sample No.
Type 5"
Depth 11,643'
Volume 2500 cc

Sample Pressure:
psig. at Surface
Gravity API @ °F
Gas/Oil Ratio Cu.Ft./bbl.

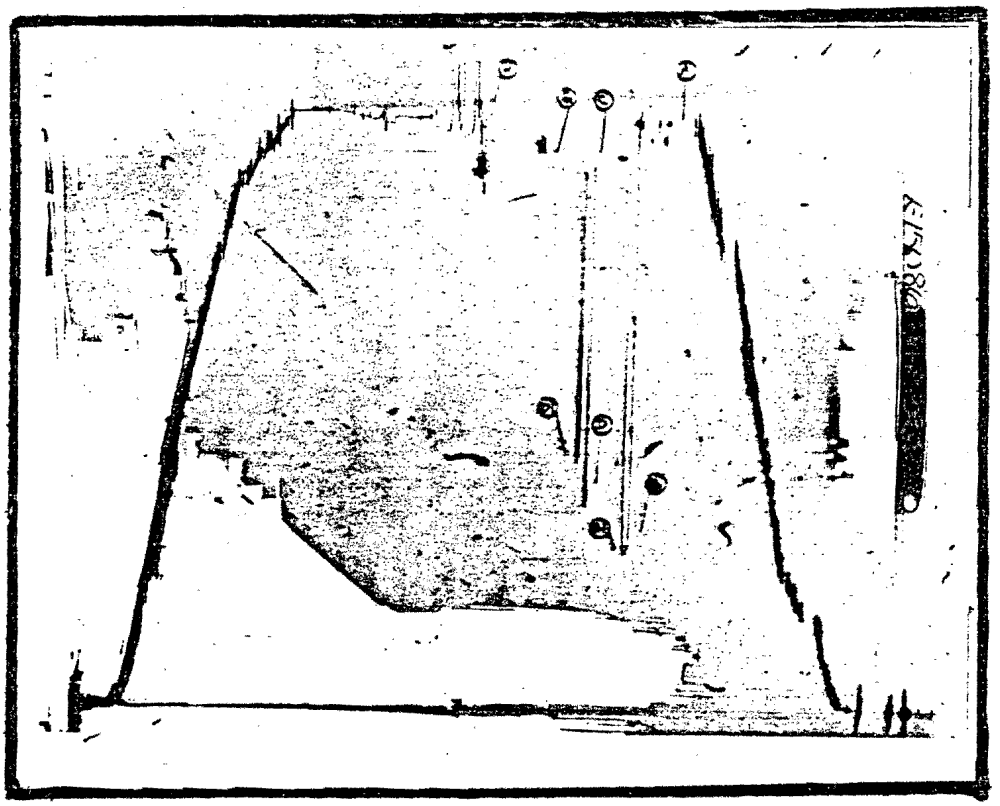
Recovery:
Cu. Ft. Gas
cc. Oil
cc. Water
cc. Mud
Total Liquid cc.

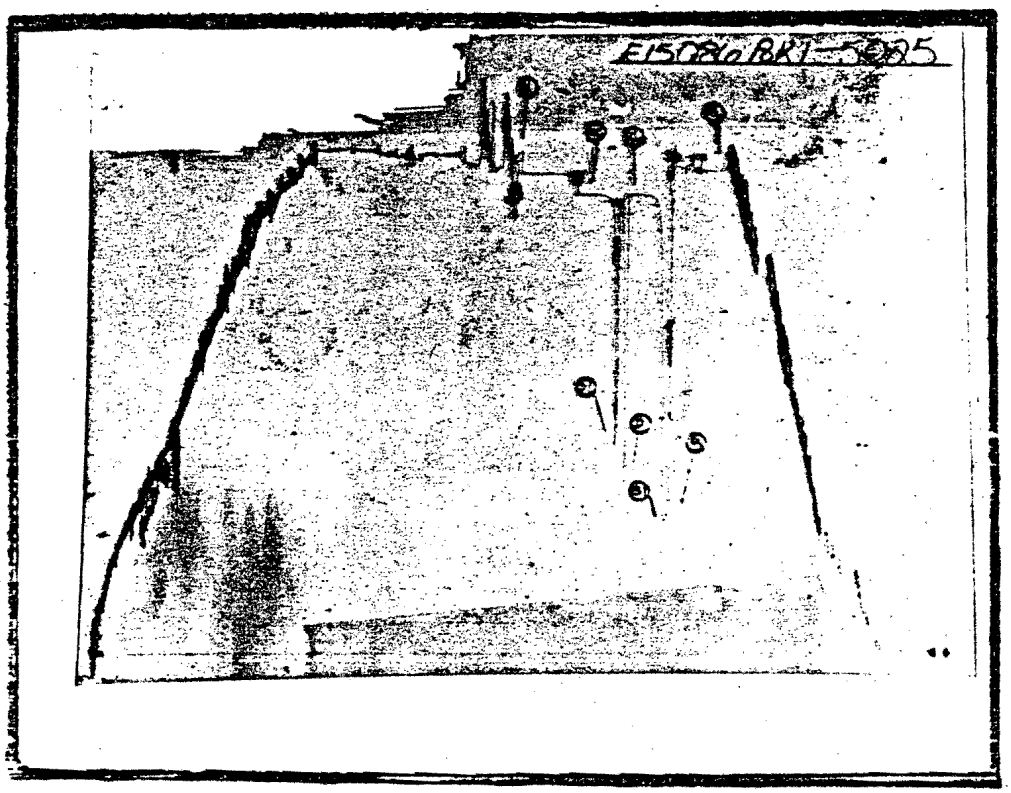
REMARKS: Temperature recorder #5365 - 0.113 Defl. - 297 °F.
MFE smaple and fluid sample #6203 sent to Fort St. John, British Columbia.

PRESSURE INCREMENTS ON RECORDER

POINT MINUTES	PRESSURE	$\frac{T + \Delta t}{\Delta t}$	POINT MINUTES	PRESSURE	$\frac{T + \Delta t}{\Delta t}$	POINT MINUTES	PRESSURE	$\frac{T + \Delta t}{\Delta t}$

JT-I&E-5B




E15086 BKT-5025

JOHNSTON TESTERS

A DIVISION OF SCHLUMBERGER CANADA LIMITED
321 - 50th AVENUE S.E. CALGARY, ALBERTA T2G 2B3

District	Fort St. John	Ticket No.	E15087
Company	Columbia Gas Development Ltd.		
Address	c/o D & S Consultants, #600, 633 - 6 Avenue S.W., Calgary, Alberta T2P 0S2	Test No.	4
J.T. No.	4		
Well Name	Columbia Gas et al Kotaneelee		
Field	Kotaneelee	Number	H-38-60-10-124
Province	Yukon Territory	Date	October 3, 1977
Co. Rep.	J. Dortch	Formation	Nahanni
Thickness			
Technician		Interval	11,695 - 11,890'
TD	11,890'		

TEST DATA

Type of Test	Open hole, Bottom hole.				
Time Started in Hole	0300	Hrs.	Tool Opened	0751	Hrs.
First Flow	5	Min.	Initial Shut-In	60	Min.
Second Flow		Min.	Second Shut In		Min.
Third Flow		Min.	Final Shut In		Min.
Pulled Loose @	0915	Hrs.	Out of Hole	2300	Hrs.
Wt. Set/on Packers	30,000	#	Pulled Loose Wt.	30,000	#

Description of Blow During Test: Gas to surface after 15 minutes after 2nd flow.

FLUID RECOVERY

Was Test Reverse Circulated Yes ☐ No ☒

Total Fluid Recovered: 4,200 Ft.

Description of Fluid Recovered:

3,500' Cushion
700' Drilling fluid.

GAS BLOW MEASUREMENT

Measured With: I.D. Riser

Time	Sfce. Choke		M Cubic Feet/Day
		NIL	

REMARKS: Misrun, lost packer seat.

RESISTIVITY			SALT CONTENT
Recovery Water	@	°F.	ppm.
Mud Pit sample filtrate	@	°F.	ppm.

TOOL SEQUENCE

Tool	Length	O.D.
P.O. Sub	1.00	
D P. Sub	.65	
MFE Tool	12.55	
Bypass Tool	2.85	
Recorder	4.40	
Safety Joint	1.75	
S.S. & Packer	9.30	7 1/2"
T.C. & Packer	6.55	7 1/2"
Total	39.05	
Packer Stub	1.00	
Perfs	18.00	
Recorder	4.40	
Recorder	4.40	
Sub	1.00	
Drill Collars	162.76	
Sub	1.00	
Bull Nose & Perf	2.00	
Total Interval	194.56	
TOTAL LENGTH		

Elevation G.L. 2250 K.B. 2275

Bottom Hole Choke Size 1/2"

Fluid Cushion Type Water Amt. 3500'

MUD AND HOLE DATA

Mud Type KCL W.L.

Filter Cake Visc. 41 Wt. 9.9

Time Taken 1800 hours

Contractor Nabors Drilling Rig No. 9

Drill Pipe Size 4 1/2" IF

Drill Collar Size 4 1/2" XH &

Drill Collar Length 462' &

Main Hole Size 8 1/2" Rat Hole

Distribution of Reports: 12 - Calgary Attention: Mrs. Wiebe

JOHNSTON
Schlumberger

JOHNSTON TESTERS

A DIVISION OF SCHLUMBERGER CANADA LIMITED
321 - 50th AVENUE S.E. CALGARY, ALBERTA T2G 2B3

E15087

PRESSURE DATA

INSTRUMENT No.		AK1-4371	AK1-2095	AK1-5025	T-5365
CAPACITY (psig)		7400	7450	8650	200-549 °F
INSTRUMENT DEPTH FT.		11673	11714	11718	11731
INSTRUMENT OPENING		Inside	Outside	Outside	Outside
WELL TEMP. °F.					
INITIAL HYDROSTATIC	A	5873#	5919#	5933#	
FIRST FLOW	B	2360#	2370#	2370#	
	B-1	2545#	2545#	2544#	
INITIAL SHUT-IN	C	5622#	5631#	5631#	
SECOND FLOW	D	2733#	2732#	2725#	
	D-1	2829#	2841#	2841#	
SECOND SHUT-IN	E				
THIRD FLOW	F				
	F-1				
FINAL SHUT-IN	G				
FINAL HYDROSTATIC	H	5893#	5937#	5944#	

FLUID SAMPLE REPORT

Sample No. 561 & 519
Type 5"
Depth 11,658'
Volume 2500 cc

Sample Pressure:
psig. at Surface
Gravity API @ °F
Gas/Oil Ratio Cu.Ft./bbl.

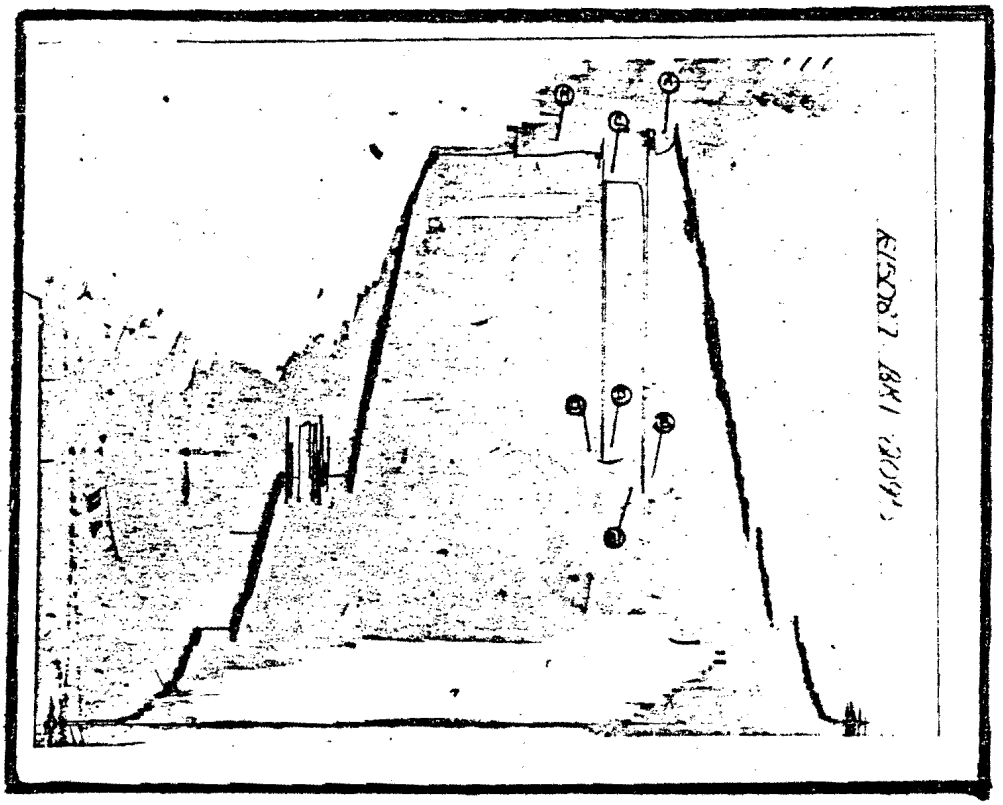
Recovery:
Cu. Ft. Gas
cc. Oil
cc. Water
cc. Mud
Total Liquid cc.

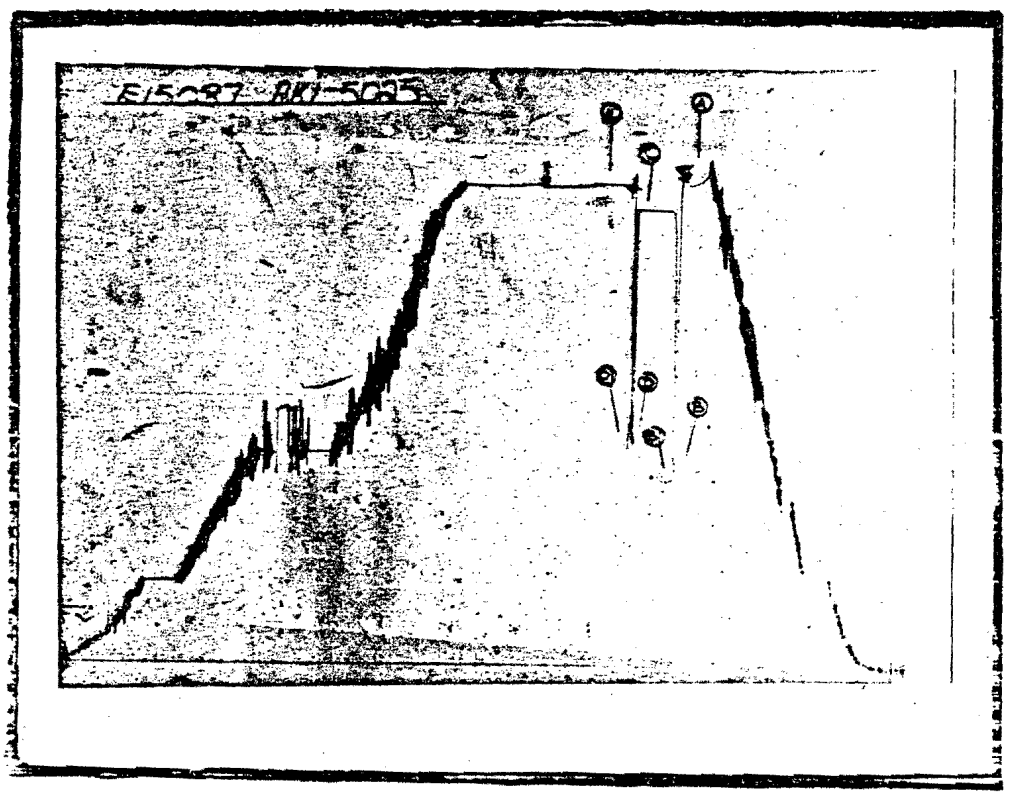
REMARKS: Temperature recorder #5635 - 0.127 - 307°F.

PRESSURE INCREMENTS ON RECORDER

POINT MINUTES	PRESSURE	$\frac{T + \Delta t}{\Delta t}$	POINT MINUTES	PRESSURE	$\frac{T + \Delta t}{\Delta t}$	POINT MINUTES	PRESSURE	$\frac{T + \Delta t}{\Delta t}$

JT-IBE-SB


E15097 BKI 5095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5

JOHNSTON
Schlumberger

321 - 50TH AVENUE S.E. • CALGARY, ALBERTA T2G 2B3 • PH. (403) 255-1151

DRILL STEM TEST SPECIAL DATA ANALYSIS

Columbia Gas Development DST #5
Columbia Gas et al Kotaneelee H-38-60-10-124
E15088 'Nahanni 11,625 - 11,890' 11,890'
October 4, 1977

October 12, 1977

ATTENTION: JIM MACDONALD

Gentlemen:.

The enclosed test appears to be a good mechanical drill stem test during which the tools functioned properly, and the formation produced enough reservoir fluid for proper identification. Reservoir pressure drawdown was sufficient and adequate shut-in build-ups occurred for reliable quantitative analysis.

1. Flow Rate: A flow rate of 4700 MCF/day of gas was noted during this test.

2. Reservoir Pressure: Extrapolation of the initial shut-in pressure build-up indicates a maximum reservoir pressure of 5655 psig at recorder depth. Extrapolation of the final shut-in pressure build-up indicates a maximum reservoir pressure of 5638 psig at recorder depth. The difference between the initial and final shut-in pressure of 17 psi is insignificant.

3. Permeability: The calculated transmissibility factor of 5879 md.ft./cp. indicates an average effective permeability to gas of .59 md. for the reported 250 foot porous interval. The calculations were based on a slope of 1,060,000 psi^2/ log cycle obtained from the final shut-in build-up plot. It was assumed for these calculations: (a) gas gravity 0.70, (b) viscosity .025 cp., (c) and gas deviation factor 1.07. These figure were obtained from the available technical literature.

4. Well Bore Damage: The calculated damage ratio of 6.40 indicates that well bore damage is present at the time and conditions of this test. This value appears to be excessive and may be due to the partial penetration of the net productive interval by the test interval. If subsequent information confirms this possibility then the value D.T. should be discounted.

5. Radius of Investigation: The calculated radius of investigation of relatively low permeability effective to the reservoir fluid and well more damage is indicated. No unusual characteristics were noted from the analysis of the test data presented.

Yours truly,

Jose Cuesta

JC/jmh

WELL: COLUMBIA GAS ET AL KOTANEELF H38 JT5

FLOW RATE PRIOR TO SHUT IN	(MCF/DAY)	4700.000
COMPRESSIBILITY FACTOR Z		1.0700
HORNER PLOT SLOPE	(PSI^2/LOG CYCLE)	1060000.
VISCOSITY	(CP)	0.025
NET THICKNESS	(FT)	250.000
MAX RESERVOIR PRESSURE	(PSIG)	5655.0
FLOWING PRESSURE	(PSIG)	895.0
FLOW TIME	(MIN)	130.0
POROSITY		0.050
COMPRESSIBILITY	(1/PSI)	0.00012000
WELL BORE RADIUS	(IN)	4.25
WELL ELEVATION	(FT)	2275.0
RECORDER DEPTH	(FT)	11645.0
TEMPERATURE	(DF)	297.0

TRANSMISSIBILITY	(MD-FT/CP)	5879.23
FLOW CAPACITY	(MD-FT)	146.98
AVERAGE EFF. PERMEABILITY	(MD)	0.59
DAMAGE RATIO		6.40
FLOW RATE WITH DAMAGE REMOVED	(MCF/DAY)	30058.81E
POTENTIOMETRIC SURFACE	(FT)	3687.4
RADIUS OF INVESTIGATION	(FT)	94.1

RESERVOIR PRESSURE PLOT

JOHNSTON Schlumberger

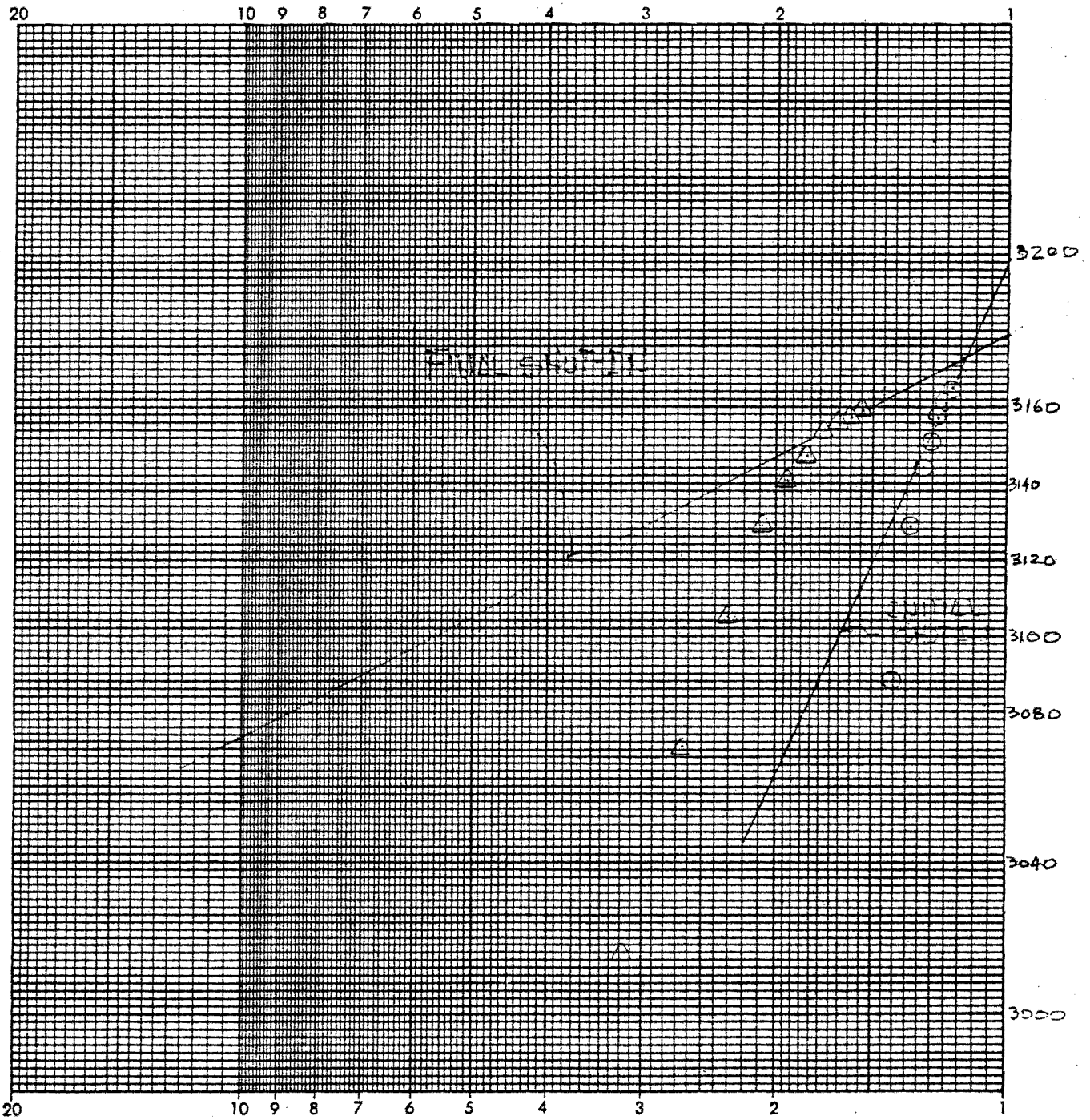
RECORDER No. LV1-2095 CAPACITY 7450 FIELD REPORT No. E15088

MAXIMUM RESERVOIR PRESSURE P_o = 5655 psig INITIAL SHUT-IN = 5655

SLOPE OF SHUT-IN CURVE M 1 = 1060000 psig/LOG CYCLE FINAL SHUT-IN = 5638

SLOPE M 1 = P_1 3179000 P_{10} 3073000 = psig/LOG CYCLE 1060000

SLOPE M 2 = P_1 ..... P_{10} ..... = ... psig/LOG CYCLE .....



JOHNSTON TESTERS

A DIVISION OF SCHLUMBERGER CANADA LIMITED
321 - 50th AVENUE S.E. CALGARY, ALBERTA T2G 2B3

District	Fort St. John	Ticket No.	E15088
Company	Columbia Gas Development Ltd.		
Address	c/o D & S Consultants, 600, 633 -6 Avenue S.W., Calgary, Alberta T2P 0S2	Test No.	5
J.T. No.	5		
Well Name	Columbia Gas et al Kotaneelee		
Field	Kotaneelee	Number	H-38-60-10-124
Province	British Columbia	Date	October 4, 1977
Co. Rep.	J. Dortch	Formation	Nahanni
Technician	T. Thompson	Interval	11,625 - 11,890
Thickness TD	11,890'		

TEST DATA

Type of Test	Open hole, Bottom hole.				
Time Started in Hole	0430	Hrs.	Tool Opened	1128	Hrs.
First Flow	10	Min.	Initial Shut-In	60	Min.
Second Flow	120	Min.	Second Shut In	240	Min.
Third Flow		Min.	Final Shut In		Min.
Pulled Loose @	1830	Hrs.	Out of Hole	0200	Hrs.
Wt. Set/on Packers	30,000	#	Pulled Loose Wt.	30,000	#

Description of Blow During Test: Good initial puff on preflow with gas to surface in 45 minutes of initial shut-in. Water to surface in 10 minutes of value opening with good gas flow in 5 minutes. Increasing to strong gas and water blow in 20 minutes.

FLUID RECOVERY

Was Test Reverse Circulated Yes ☐ No ☒

Total Fluid Recovered: 80 Ft.

Description of Fluid Recovered:

80' Gasified mud cut water.

GAS BLOW MEASUREMENT

Measured With Willis Choke 2 " I.D. Riser

Time	Sfce. Choke	Reading Psi	M Cubic Feet/Day
1320	64	380	10,000 Wet gas flow
1330	64	350	9,300 Wet gas flow
1340	64	320	8,600 Wet gas flow
1350	64	280	7,100 Wet gas flow
1400	48	320	4,700 Wet gas flow
1410	48	320	4,700 Wet gas flow
1420	48	320	4,700 Wet gas flow
1430	48	320	4,700 Wet gas flow

REMARKS: Test satisfactory.

RESISTIVITY / Chloride CONTENT

Recovery Water	@	°F.	44,500	ppm.
Mud Pit sample filtrate	@	°F.		ppm.

TOOL SEQUENCE

Tool	Length	O.D.
P.O. Sub	1.00	
D.P. Sub	.65	
MFE Tool	12.55	
Bypass Tool	2.85	
Recorder	4.40	
Safety Joint	1.75	
S.S. & Packer	9.30	7 1/2"
T.C. & Packer	5.35	7 1/2"
Packer	4.35	7 1/2"
Total	42.20	
Packer Stub	1.00	
Perfs	15.00	
Recorder	4.40	
Recorder	4.40	
Sub	1.00	
Drill Collars	236.48	
Sub	1.00	
Bull Nose & Perf	2.00	
Total Interval	265.28	
TOTAL LENGTH		

Elevation G.L. 2250 K.B. 2275

Bottom Hole Choke Size 1/2"

Fluid Cushion Type Water Amt. 3500'

MUD AND HOLE DATA

Mud Type KCL W.L.

Filter Cake Visc. 41 Wt. 9.9

Time Taken 2400 hours

Contractor NaborsDrilling Rig No. 9

Drill Pipe Size 4 1/2" IF

Drill Collar Size 4 1/2" XH &

Drill Collar Length 865' &

Main Hole Size Rat Hole 8 1/2"

Distribution of Reports 12 - Calgary Attention: MRS. WIEBE

JOHNSTON 5

Schlumberger

JOHNSTON TESTERS

A DIVISION OF SCHLUMBERGER CANADA LIMITED

321 - 50th AVENUE S.E. CALGARY, ALBERTA T2G 2B3

E15088

PRESSURE DATA

INSTRUMENT No.		AK1-4371	AK1-2095	AK1-5025	T-5365
CAPACITY (psig)		7400	7450	8650	200-549 °F
INSTRUMENT DEPTH FT.		11604	11641	11645	11650
INSTRUMENT OPENING		Inside		Outside	Outside
WELL TEMP. °F.	297				
INITIAL HYDROSTATIC	A	5860#	5893#	5885#	
FIRST FLOW	B	1598#	1618#	1590#	
	B-1	1624#	1653#	1618#	
INITIAL SHUT-IN	C	5585#	5616#	5589#	
SECOND FLOW	D	1795#	1821#	*	
	D-1	871#	895#		
SECOND SHUT-IN	E				
THIRD FLOW	F				
	F-1				
FINAL SHUT-IN	G	5575#	5608#		
FINAL HYDROSTATIC	H	5794#	5839#		

FLUID SAMPLE REPORT

Sample No. 561 & 556

Type

Depth 11,597'

Volume

Sample Pressure:

psig. at Surface

Gravity API @ °F

Gas/Oil Ratio Cu.Ft./bbl.

Recovery:

Cu. Ft. Gas

cc. Oil

cc. Water

cc. Mud

Total Liquid cc.

REMARKS: *False pressures, initial shut-in still building when clock stopped.

Temperature recorder #5365 - 0.113 Defl. = 297 °F.

MFE sample 561 and fluid sample #6203 sent to C & G Labs., Fort St. John.

PRESSURE INCREMENTS ON RECORDER

Initial Shut-in

POINT MINUTES	PRESSURE	$\frac{T + \Delta t}{\Delta t}$
0	1884	-----
5	2936	3.000
10	4338	2.000
15	5170	1.666
20	5444	1.500
25	5557	1.400
30	5594	1.333
35	5608	1.285
40	5614	1.250
45	5619	1.222
50	5623	1.200
55	5626	1.181
60	5629	1.166

Final Shut-in

POINT MINUTES	PRESSURE	$\frac{T + \Delta t}{\Delta t}$
0	895	------
10	3396	14.000
20	4937	7.500
30	5246	5.333
40	5378	4.250
50	5447	3.600
60	5492	3.166
80	5542	2.625
100	5573	2.300
120	5594	2.083
140	5605	1.928
160	5610	1.812
180	5616	1.722
200	5618	1.650
220	5619	1.590
240	5621	1.541

POINT MINUTES	PRESSURE	$\frac{T + \Delta t}{\Delta t}$

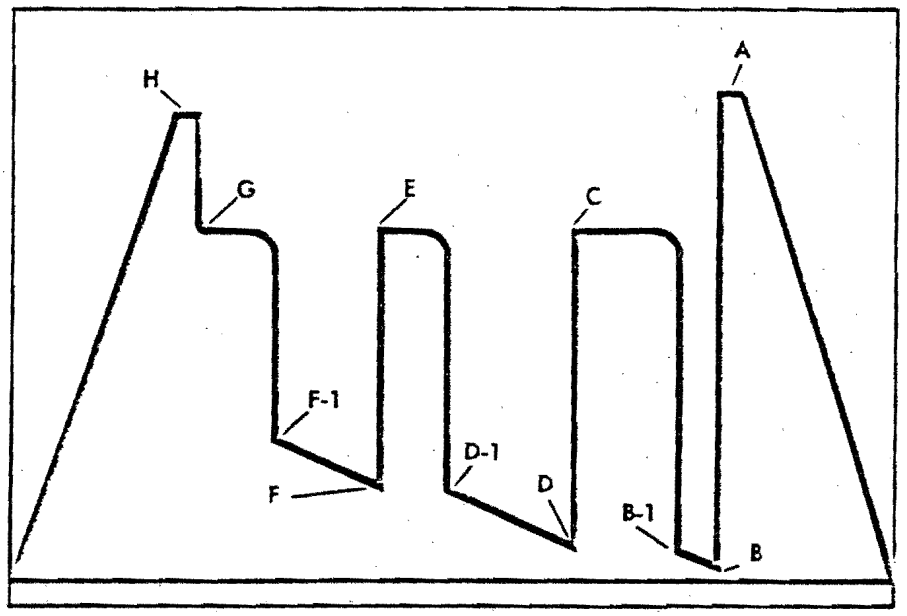
JT-1&E-68

Schlumberger

321 - 50TH AVENUE S.E. • CALGARY, ALBERTA T2G 2B3 • PH. (403) 255-1151

GUIDE TO IDENTIFICATION OF DRILL STEM TEST PRESSURE CHARTS

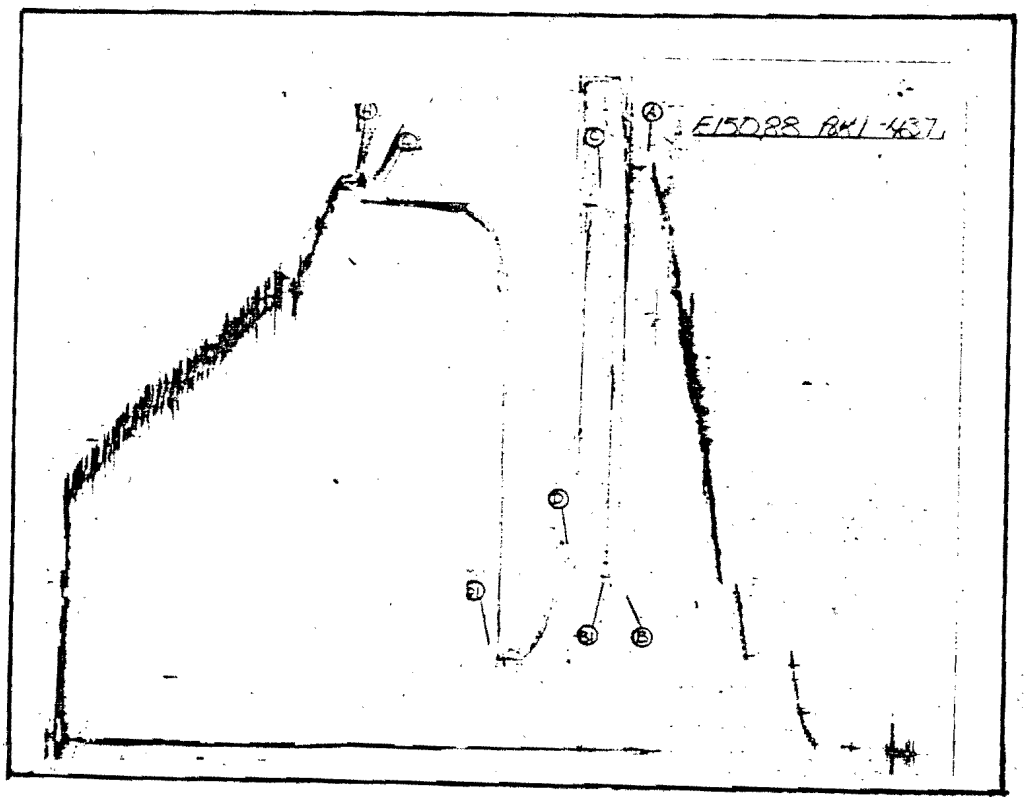
FIELD REPORT NO.	RECORDER NO.
E15088	AK1-4371



A. Initial Hyd. Mud
B. First Flow
C. Initial Shut-In
D. Second Flow
E. Second Shut-In
F. Third Flow
G. Final Shut-In
H. Final Hyd. Mud

The following points are either fluctuating pressures or points indicating other packer settings (testing different zones).

A-1, A-2, A-3, etc. Initial Hyd. Pressures
Z — Special pressure points such as pumping pressures recorded for formation breakdown.



D&S PETROLEUM CONSULTANTS LTD.

CASING SUMMARY

73F2

Casing Size 20" Casing Type Surface

Well COLUMBIA ET AL KOTANEELEE YT H38 Date April 22/77

	CSG WT	GR	RGE	THD	T&C	MAKE	JTS RUN	DEPTH LANDED	FT. RUN IN WELL
Shoe	MAKE: Baker			TYPE: Float					
Shoe JT.									
Float Collar	MAKE: Baker			TYPE: Float					
Casing	94	E	3	Butt.	S&TC	Mann.	19	770.00	772.99
Casing									
Casing									
Casing									
Casing									

Landing Jt (when used) Length.....	
Overall Length of Casing String	772.99
Feet up from K.B. (subtract).....	2.99
Setting Depth: Driller ____ Tally	770.00

Centralizers 3

Scratchers yes

Weld/Thread Lock (No. Joints) welded and thread locked, first 3 joints

Cementing Co. Nowsco Cementer: Bill Miller

Cement Volume 700 cu. ft.

Additives 2% Cal.

Displacement Calculated 30 bbls Measured 221 bbls

Top Plug rubber Bottom Plug rubber Other

Circ. Time Before Cement 1 hr Bbls. Wash 20

Start Mix 5:54 AM PM 190 min: Displace 6 B.P.M. min:

Plug Down 7:07 AM PM FWP psi BPP 1200 psi

Remarks

John Dortch
Fld. Supervisor

D&S PETROLEUM CONSULTANTS LTD.

TUBULAR TALLY

73F4

WELL: COLUMBIA ET AL KOTANEELEE YT H38 DATE: April 22 1977

Size: 20" Weight: 94# #/Ft. Thread Buttress Grade: H-40 Make: Mannesman

Joint Number	LENGTH		Joint Number	LENGTH		Joint Number	LENGTH		Joint Number	LENGTH		Joint Number	LENGTH	
S&F	45	21	21			41			61			81		
2	41	74	22			42			62			82		
3	35	15	23			43			63			83		
4	42	97	24			44			64			84		
5	39	31	25			45			65			85		
6	40	63	26			46			66			86		
7	40	96	27			47			67			87		
8	40	00	28			48			68			88		
9	41	16	29			49			69			89		
10	38	52	30			50			70			90		
TOTAL	405	65	TOTAL			TOTAL			TOTAL			TOTAL		
Joint Number	LENGTH		Joint Number	LENGTH		Joint Number	LENGTH		Joint Number	LENGTH		Joint Number	LENGTH	
11	39	65	31			51			71			91		
12	41	86	32			52			72			92		
13	39	82	33			53			73			93		
14	42	55	34			54			74			94		
15	41	08	35			55			75			95		
16	42	95	36			56			76			96		
17	37	98	37			57			77			97		
18	39	71	38			58			78			98		
19	41	74	39			59			79			99		
20			40			60			80			100		
TOTAL	367	34	TOTAL			TOTAL			TOTAL			TOTAL		

TALLY SUMMARY

GROUP NO.	LENGTH		JTS	LENGTH	
1-10	405	65	19	767	99
11-20	367	34	Shoe & Float	5	00
21-30					
31-40					
41-50				772	99
51-60					
61-70					
71-80					
81-90					
91-100					
TOTAL	772	99			

BROUGHT FORWARD

PAGE TOTAL

TOTAL ON LOCATION

TOTAL LEFT OUT (incl. L.J.)

TOTAL PERMANENTLY IN HOLE

* Left out

** Damaged

(Note transfer of left out joints to where and by whom.)

REMARKS: (Use separate page for each weight, grade or thread.)

* 6 joints total 240.47

Racked on location

Tallied by J. Dortch

D&S PETROLEUM CONSULTANTS LTD.

CASING SUMMARY

73F2

Casing Size 13 3/8" Casing Type Intermediate

Well COLUMBIA ET AL KOTANEELEE YT H38 Date June 19/77

	CSG WT	GR	RGE	THD	T&C	MAKE	JTS RUN	DEPTH LANDED	FT. RUN IN WELL
Shoe	MAKE: Baker			TYPE: Float					
Shoe JT.									
Float Collar	MAKE: Baker			TYPE: Float					
Casing	72	N 80	3	Butt.	LT&C	Oilwell	76		3022.54
Casing									
Casing									
Casing									
Casing									

Landing Jt (when used) Length.....	
Overall Length of Casing String.....	3022.54
Feet up from K.B. (subtract).....	2.54
Setting Depth: Driller ____ Tally	3020.00

Centralizers 3 sets straps

Scratchers yes

Weld/Thread Lock (No. Joints) 3 welded and thread locked

Cementing Co. Nowsco Cementer: Bill Miller

Cement Volume 2500 cu. ft.

Additives

Displacement Calculated 53 bbls Measured 53 bbls

Top Plug rubber Bottom Plug rubber Other

Circ. Time Before Cement 2 hrs. Bbls. Wash 20 Bbls

Start Mix 5:53 AM ~~PM~~ min: Displace 70 min:

Plug Down 9:15 AM ~~PM~~ FWP psi BPP 1500 psi

Remarks

John Dortch
Fld. Supervisor

D&S PETROLEUM CONSULTANTS LTD.

TUBULAR TALLY

73F4

WELL: COLUMBIA ET AL KOTANEELEE YT H38 DATE: June 19 19 77

Size: 13 3/8 Weight: 72# #/Ft. Thread: Buttress Grade: N-80 Make: USS Oilwell

Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
1	40 05	21	40 10	41	39 58	61	39 44	81	
2	40 09	22	39 68	42	40 03	62	39 25	82	
3	39 54	23	39 35	43	39 98	63	38 98	83	
4	39 48	24	40 15	44	39 60	64	39 54	84	
5	38 05	25	36 53	45	40 15	65	38 88	85	
6	38 45	26	40 70	46	41 26	66	39 55	86	
7	39 48	27	40 25	47	40 66	67	40 90	87	
8	40 50	28	37 52	48	39 58	68	40 26	88	
9	40 35	29	39 84	49	39 48	69	37 94	89	
10	40 10	30	40 15	50	40 78	70	41 14	90	
TOTAL	396 09	TOTAL	394 27	TOTAL	401 10	TOTAL	395 88	TOTAL	
Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
11	39 55	31	40 68	51	39 85	71	39 82	91	
12	40 35	32	38 53	52	39 75	72	40 23	92	
13	40 00	33	40 30	53	40 00	73	39 65	93	
14	40 43	34	40 65	54	39 22	74	40 22	94	
15	39 05	35	39 50	55	41 18	75	40 67	95	
16	40 41	36	39 03	56	39 94	76	41 12	96	
17	39 44	37	40 15	57	39 70	77		97	
18	35 98	38	39 96	58	39 52	78		98	
19	39 48	39	37 50	59	39 76	79		99	
20	40 46	40	40 85	60	39 77	80		100	
TOTAL	395 15	TOTAL	397 15	TOTAL	397 69	TOTAL	241 71	TOTAL	

TALLY SUMMARY

GROUP NO.	LENGTH	JTS	LENGTH	
1-10	396 09	76	3019 04	BROUGHT FORWARD
11-20	395 15	shoe	1 55	PAGE TOTAL
21-30	394 27	float	1 95	TOTAL ON LOCATION
31-40	397 15			TOTAL LEFT OUT (incl. L.J.)
41-50	401 10		3022 54	TOTAL PERMANENTLY IN HOLE
51-60	397 69			
61-70	395 88			
71-80	241 71			
81-90				
91-100				
TOTAL				

* Left out

** Damaged

(Note transfer of left out joints to where and by whom.)

REMARKS: (Use separate page for each weight, grade or thread.)

Tallied by J. Dortch

D&S PETROLEUM CONSULTANTS LTD.

CASING SUMMARY

73F 2

Casing Size 9 5/8 Casing Type Intermediate

Well COLUMBIA ET AL KOTANEELEE YT H38 Date Sept 15/77

	CSG WT	GR	RGE	THD	T&C	MAKE	JTS RUN	DEPTH LANDED	FT. RUN IN WELL
Shoe	MAKE: Baker			TYPE: Guide Shoe				10,862	1.5
Shoe JT.	47	N80		8RD		MANN	1	10,819	40.63
Float Collar	MAKE: Baker			TYPE: Float Collar				10,817	1.75
Casing	47	N80		8RD		MANN	50		
Casing	Baker	Stage	Collar					8,885	
Casing	47	N80		8RD			101		
Casing	43.5	N80		BUTT			115	4,879	4879
Casing									

Landing Jt (when used) Length.....

Overall Length of Casing String .....

Feet up from K.B. (subtract).....

Setting Depth: Driller _____ Tally 10,862

Centralizers Shoe jt. collar jt, stage collar jt, all weld on

Scratchers --

Weld/Thread Lock (No. Joints) 2

Cementing Co. Nowsco Cementer:

Cement Volume 1st stage, 600 ft^3, 2nd stage 1400 ft^3

Additives 1st stage - OW NT + .8% R-55 + .5% T-10, 2nd stage OW NT+.35% R-5+.5% T-10

Displacement Calculated 1st 798 Bbls, 2nd 648 bbls Measured _____ bbls

Top Plug rubber Bottom Plug rubber Other

Circ. Time Before Cement _____ Bbls. Wash 40 Bbls water

*Start Mix 6:19 ~~AM~~ PM _____ min: Displace _____ min:

**Plug Down 5:43 AM ~~PM~~ FWP _____ psi BPP _____ psi

Remarks * Start mix first stage, ** Bump plug on second stage

John Dortch
Fld. Supervisor

D&S PETROLEUM CONSULTANTS LTD.

TUBULAR TALLY

73F 4

WELL: COLUMBIA ET AL KOTANEELEE YT H38 DATE: Sept 8 19 77

Size: 9 5/8 Weight: 47# #/Ft. Thread: N80 8 RD Grade: N80 Make: Mannesman

Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
1	40 83	21	39 16	41	37 20	61	39 35	81	35 71
2	40 47	22	41 92	42	38 03	62	41 12	82	35 16
3	38 81	23	38 54	43	44 44	63	39 49	83	40 52
4	34 35	24	43 17	44	40 33	64	40 76	84	44 41
5	40 68	25	36 44	45	43 92	65	37 98	85	43 46
6	39 92	26	39 04	46	41 57	66	39 08	86	36 97
7	36 91	27	40 20	47	40 14	67	41 30	87	41 25
8	40 77	28	39 27	48	39 74	68	41 05	88	41 02
9	38 13	29	33 79	49	37 30	69	40 15	89	47 47
10	40 78	30	41 00	50	44 40	70	38 49	90	37 28
TOTAL	391 65	TOTAL	392 53	TOTAL	407 07	TOTAL	398 77	TOTAL	403 25
Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
11	39 76	31	40 02	51	40 10	71	39 51	91	45 92
12	38 30	32	40 65	52	41 75	72	41 03	92	41 00
13	37 89	33	39 48	53	40 09	73	41 15	93	40 30
14	38 90	34	39 45	54	40 27	74	38 01	94	36 55
15	45 69	35	44 57	55	36 21	75	36 45	95	42 70
16	39 10	36	41 08	56	38 31	76	39 83	96	41 97
17	43 68	37	41 04	57	39 14	77	40 00	97	42 32
18	35 81	38	37 23	58	36 97	78	43 13	98	40 15
19	38 91	39	34 52	59	39 52	79	47 36	99	38 43
20	37 58	40	41 03	60	40 96	80	41 10	100	39 43
TOTAL	395 62	TOTAL	399 07	TOTAL	393 32	TOTAL	407 57	TOTAL	408 77

TALLY SUMMARY

GROUP NO.	LENGTH
1-10	391 65
11-20	395 62
21-30	392 53
31-40	399 07
41-50	407 07
51-60	393 32
61-70	398 77
71-80	407 57
81-90	403 25
91-100	408 77
TOTAL	3997 62

	JTS	LENGTH
BROUGHT FORWARD		
PAGE TOTAL	100	3997 62
TOTAL ON LOCATION		
TOTAL LEFT OUT (incl. L.J.)		
TOTAL PERMANENTLY IN HOLE		

* Left out

** Damaged

(Note transfer of left out joints to where and by whom.)

REMARKS: (Use separate page for each weight, grade or thread.)

Threads on - 3997.62

Thread make up - 39.58

Thread off - 3958.04

Tallied by John Dortch

D&S PETROLEUM CONSULTANTS LTD.

TUBULAR TALLY

73F 4

WELL: COLUMBIA ET AL KOTANEELEE YT H38 DATE: Sept 6 19 77

Size: 9 5/8 Weight: 47# #/Ft. Thread: 8 RD Grade: N 80 Make: Mannesman

Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
1	37 80	21	40 05	41	39 18	61		81	
2	39 56	22	41 62	42	39 76	62		82	
3	40 59	23	40 62	43	41 23	63		83	
4	41 24	24	40 40	44	41 75	64		84	
5	40 65	25	37 35	45	36 55	65		85	
6	41 38	26	39 44	46	41 21	66		86.	
7	36 40	27	37 05	47	39 98	67		87	
8	39 70	28	41 21	48	38 49	68		88	
9	40 95	29	40 90	49	43 86	69		89	
10	36 30	30	40 40	50	41 70	70		90	
TOTAL	394 57	TOTAL	399 04	TOTAL	403 73	TOTAL		TOTAL	
Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
11	39 13	31	38 14	51	41 25	71		91	
12	42 30	32	37 26	52		72		92	
13	37 57	33	40 91	53		73		93	
14	37 98	34	42 11	54		74		94	
15	39 30	35	37 43	55		75		95	
16	41 42	36	40 02	56		76		96	
17	40 38	37	46 58	57		77		97	
18	37 31	38	42 01	58		78		98	
19	36 82	39	36 71	59		79		99	
20	39 13	40	43 21	60		80		100	
TOTAL	391 34	TOTAL	404 38	TOTAL	41 25	TOTAL		TOTAL	

TALLY SUMMARY

GROUP NO.	LENGTH	JTS	LENGTH	
1-10	394 57	100	3997 62	BROUGHT FORWARD
11-20	391 34	51	2034 31	PAGE TOTAL
21-30	399 04			TOTAL ON LOCATION
31-40	404 38			TOTAL LEFT OUT (incl. L.J.)
41-50	403 73			TOTAL PERMANENTLY IN HOLE
51-60	41 25			
61-70				
71-80				
81-90				
91-100				
TOTAL	2034 31			

* Left out

** Damaged

(Note transfer of left out joints to where and by whom.)

REMARKS: (Use separate page for each weight, grade or thread.)

Threads on - 2034.31

Thread make up - 20.19

Threads off - 2014.11

Tallied by John Dortch

D&S PETROLEUM CONSULTANTS LTD.

TUBULAR TALLY

73F 4

WELL: COLUMBIA ET AL KOTANEELEE YT H38 DATE: Sept 8 19 77

Size: 9 5/8 Weight: 43.5 #/Ft. Thread: Buttress Grade: N 80 Make: Mannesman

Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
1	40 16	21	38 22	41	43 70	61	44 05	81	45 08
2	39 91	22	45 00	42	43 51	62	39 88	82	41 74
3	41 40	23	45 78	43	42 60	63	42 85	83	41 94
4	37 86	24	44 11	44	41 17	64	44 35	84	44 20
5	41 25	25	47 37	45	43 15	65	41 30	85	43 92
6	45 11	26	43 91	46	45 00	66	42 22	86	44 33
7	42 65	27	43 80	47	41 39	67	38 30	87	42 85
8	46 93	28	37 56	48	42 10	68	34 55	88	46 70
9	41 50	29	42 56	49	41 80	69	44 09	89	44 56
10	40 86	30	43 59	50	40 71	70	43 29	90	43 25
TOTAL	417 63	TOTAL	431 90	TOTAL	425 13	TOTAL	414 88	TOTAL	438 57
Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
11	44 55	31	41 69	51	43 92	71	39 20	91	42 55
12	40 10	32	40 57	52	44 59	72	44 20	92	42 75
13	44 97	33	44 35	53	43 72	73	40 53	93	41 05
14	43 56	34	39 30	54	47 43	74	44 54	94	44 54
15	39 62	35	42 15	55	44 78	75	37 60	95	45 78
16	44 11	36	43 68	56	40 94	76	43 80	96	42 12
17	44 66	37	42 44	57	43 40	77	41 86	97	44 70
18	41 25	38	44 68	58	43 72	78	44 88	98	44 01
19	43 25	39	43 40	59	44 15	79	36 43	99	43 84
20	43 82	40	43 45	60	46 58	80	42 94	100	40 50
TOTAL	429 89	TOTAL	425 71	TOTAL	443 23	TOTAL	415 98	TOTAL	431 84

TALLY SUMMARY

GROUP NO.	LENGTH	JTS	LENGTH
1-10	417 63	151	6031 93
11-20	429 89	100	4274 76
21-30	431 90		
31-40	425 71		
41-50	425 13		
51-60	443 23		
61-70	414 88		
71-80	415 98		
81-90	438 57		
91-100	431 84		
TOTAL	4274 76		

BROUGHT FORWARD		
PAGE TOTAL		
TOTAL ON LOCATION		
TOTAL LEFT OUT (incl. L.J.)		
TOTAL PERMANENTLY IN HOLE		

* Left out

** Damaged

(Note transfer of left out joints to where and by whom.)

REMARKS: (Use separate page for each weight, grade or thread.)

Thread on - 4274.76

Thread make up - 40.10

Threads off - 4234.66

Tallied by John Dortch

D&S PETROLEUM CONSULTANTS LTD.

TUBULAR TALLY

73F 4

WELL: COLUMBIA ET AL KOTANEELEE YT H38 DATE: Sept 8 19 77

Size: 9 5/8 Weight: 43.5 #/Ft. Thread: Buttress Grade: N 80 Make: Mannesman

Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
1	44 35	21		41		61		81	
2	42 20	22		42		62		82	
3	45 33	23		43		63		83	
4	41 15	24		44		64		84	
5	45 30	25		45		65		85	
6	41 60	26		46		66		86	
7	44 60	27		47		67		87	
8	42 90	28		48		68		88	
9	43 67	29		49		69		89	
10	45 00	30		50		70		90	
TOTAL	436 10	TOTAL		TOTAL		TOTAL		TOTAL	
Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
11	42 80	31		51		71		91	
12	44 48	32		52		72		92	
13	42 26	33		53		73		93	
14	45 70	34		54		74		94	
15	41 29	35		55		75		95	
16	42 00	36		56		76		96	
17	44 55	37		57		77		97	
18	42 40	38		58		78		98	
19		39		59		79		99	
20		40		60		80		100	
TOTAL	345 48	TOTAL		TOTAL		TOTAL		TOTAL	

TALLY SUMMARY

GROUP NO.	LENGTH	JTS	LENGTH	
1-10	436 10	251	10306 69	BROUGHT FORWARD
11-20	345 48	18	7158	PAGE TOTAL
21-30				TOTAL ON LOCATION
31-40				TOTAL LEFT OUT (incl. L.J.)
41-50		269	1108827	TOTAL PERMANENTLY IN HOLE
51-60				
61-70				
71-80				
81-90				
91-100				
TOTAL	781 58			

* Left out

** Damaged

(Note transfer of left out joints to where and by whom.)

REMARKS: (Use separate page for each weight, grade or thread.)

Threads on - 781.58

Thread make up - 7.22

Threads off - 774.36

Tallied by John Dortch

D&S PETROLEUM CONSULTANTS LTD.

CASING SUMMARY

73F2

Casing Size 7" Casing Type 32#/ft LT&C N-80 29#/ft Butt, N-80

Well COLUMBIA ET AL KOTANEELEE YT H38 Date October 15, 1977

	CSG WT	GR	RGE	THD	T&C	MAKE	JTS RUN	DEPTH LANDED	FT. RUN IN WELL
Shoe	MAKE: Baker			TYPE: FLoat				12789	1.50
Shoe JT.	32	N-80		8RD			1		36.30
Float Collar	MAKE: Baker			TYPE: Float				12752	1.50
Casing	32	N-80		8RD					8859.26
Casing	29	N-80		Butt					3897.00
Casing									
Casing									
Casing									

Landing Jt (when used) Length.....	
Overall Length of Casing String.....	12795.56
Feet up from K.B. (subtract).....	6.56
Setting Depth: Driller ____ Tally	12789.00

Centralizers none

Scratchers none

Weld/Thread Lock (No. Joints) none

Cementing Co. Nowsco Cementer: Don Chris

Cement Volume 500 sacks Oilwell Class "G"

Additives 30% Silica Flour, 1% R-55, .5% T-10

Displacement Calculated 465 (water) bbls Measured 465 bbls

Top Plug calc. 12749, actual 12681 Bottom Plug ____ Other ____

Circ. Time Before Cement 4 hours ~~MMX~~. Wash 5 Bbls water

Start Mix 1:45 AM ~~PM~~ ____ min: Displace ____ min:

Plug Down 3:50 AM ~~PM~~ FWP 300 psi BPP 3000 psi
(Oct 19/77)

Remarks

Ralph Lane
Fld. Supervisor

D&S PETROLEUM CONSULTANTS LTD.

TUBULAR TALLY

73F 4

WELL: COLUMBIA ET AL KOTANEELEE YT H38 DATE: Oct 15 19 77

Size: 7" Weight: 32 #/Ft. Thread: LT&C Grade: N-80 Make:

Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
1	43 54	21	40 68	41	41 01	61	39 47	81	41 05
2	40 58	22	43 48	42	38 88	62	41 56	82	40 80
3	43 68	23	39 98	43	39 80	63	40 57	83	38 91
4	42 89	24	38 66	44	36 41	64	42 25	84	44 00
5	44 61	25	40 18	45	39 54	65	42 18	85	39 90
6	40 40	26	41 77	46	31 78	66	39 85	86	41 44
7	35 03	27	44 17	47	37 89	67	43 05	87	39 79
8	42 94	28	40 55	48	40 86	68	33 51	88	43 58
9	** 38 71	29	40 50	49	40 55	69	41 30	89	41 12
10	39 28	30	37 15	50	42 05	70	38 22	90	41 67
TOTAL	411 66	TOTAL	407 12	TOTAL	388 77	TOTAL	401 96	TOTAL	412 26
Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
11	38 91	31	40 54	51	40 62	71	42 98	91	41 68
12	40 32	32	42 68	52	39 40	72	40 85	92	42 30
13	38 29	33	40 17	53	40 20	73	43 11	93	40 89
14	40 75	34	41 18	54	39 85	74	43 91	94	39 53
15	36 20	35	39 75	55	40 84	75	41 75	95	41 10
16	38 97	36	39 19	56	43 04	76	41 17	96	41 75
17	40 20	37	40 95	57	41 00	77	40 03	97	34 89
18	42 12	38	40 18	58	43 48	78	41 13	98	42 10
19	41 08	39	37 36	59	40 13	79	40 16	99	40 09
20	37 66	40	38 71	60	41 29	80	42 60	100	39 13
TOTAL	394 50	TOTAL	400 71	TOTAL	409 85	TOTAL	407 69	TOTAL	403 46

TALLY SUMMARY

GROUP NO.	LENGTH	JTS	LENGTH	
1-10	411 66			BROUGHT FORWARD
11-20	394 50	100	4014 98	PAGE TOTAL
21-30	407 12			TOTAL ON LOCATION
31-40	400 71			TOTAL LEFT OUT (incl. L.J.)
41-50	388 77			TOTAL PERMANENTLY IN HOLE
51-60	409 85			
61-70	401 96			
71-80	417 69			
81-90	412 26			
91-100	403 46			
TOTAL	4047 98			

* Left out

** Damaged

(Note transfer of left out joints to where and by whom.)

REMARKS: (Use separate page for each weight, grade or thread.)

NOTE: pipe measured with threads on, deduct .33ft/jt

or 33 feet.

Total this page, 4014.98

Tallied by J. Dortch

D&S PETROLEUM CONSULTANTS LTD.

TUBULAR TALLY

73F 4

WELL: COLUMBIA ET AL KOTANEELEE YT H38 DATE: Oct 15 19 77

Size: 7" Weight: 32 #/Ft. Thread: LT&C Grade: N-80 Make:

Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
1 C J	40 39	21	** 42 94	41	39 20	61	39 10	81	42 50
2	38 90	22	43 78	42	** 36 69	62	41 51	82	39 22
3	** 39 44	23	38 98	43	38 71	63	40 40	83	41 55
4	38 40	24	42 35	44	38 89	64	39 78	84	** 42 02
5	35 83	25	41 43	45	37 30	65	41 57	85	41 02
6	39 24	26	41 14	46	40 40	66	37 19	86	39 00
7	36 40	27	41 40	47	42 78	67	32 23	87	43 00
8	37 33	28	37 93	48	38 19	68	41 30	88	38 26
9	39 15	29	42 23	49	36 31	69	41 47	89	38 01
10	39 35	30	43 60	50	39 00	70	39 82	90	30 13
TOTAL	384 43	TOTAL	415 78	TOTAL	387 47	TOTAL	394 37	TOTAL	394 71
Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
11	40 85	31	37 53	51	35 20	71	37 92	91	41 94
12	35 20	32	35 68	52	25 29	72	39 90	92	36 60
13	38 84	33	39 96	53	36 30	73	41 74	93	27 98
14	39 69	34	42 71	54	41 13	74	42 05	94	42 80
15	38 18	35	43 45	55	** 40 58	75	43 31	95	42 15
16	43 25	36	38 20	56	42 00	76	36 55	96	** 43 45
17	42 61	37	40 35	57	36 57	77	27 36	97	** 41 60
18	41 22	38	43 10	58	40 98	78	42 80	98	** 37 58
19	36 42	39	38 15	59	43 02	79	40 79	99	** 28 58
20	41 93	40	43 20	60	43 02	80	37 92	200	42 14
TOTAL	398 19	TOTAL	402 33	TOTAL	384 09	TOTAL	390 34	TOTAL	384 82

TALLY SUMMARY

GROUP NO.	LENGTH	JTS	LENGTH	
1-10	384 43	100	4014	98
11-20	398 19	100	3903	53
21-30	415 78			
31-40	402 33			
41-50	387 47			
51-60	384 09			
61-70	394 37			
71-80	390 34			
81-90	394 71			
91-100	384 82			
TOTAL	3936 53			

BROUGHT FORWARD	
PAGE TOTAL	
TOTAL ON LOCATION	
TOTAL LEFT OUT (incl. L.J.)	
TOTAL PERMANENTLY IN HOLE	

* Left out

** Damaged

(Note transfer of left out joints to where and by whom.)

REMARKS: (Use separate page for each weight, grade or thread.)

NOTE: pipe measured with threads on, deduct .33ft/jt or 33 feet.

Total this page - 3903.53 feet

Tallied by

D&S PETROLEUM CONSULTANTS LTD.

TUBULAR TALLY

73F 4

WELL: COLUMBIA ET AL KOTANEELEE YT H38 DATE: Oct 15 1977

Size: 7" Weight: 32 #/Ft. Thread: LT&C Grade: N-80 Make:

Joint Number	LENGTH		Joint Number	LENGTH		Joint Number	LENGTH		Joint Number	LENGTH		Joint Number	LENGTH	
201	38	46	21	32	60	41			61			81		
2	40	80	22	40	90	42			62			82		
3	37	85	23	30	58	43			63			83		
4	40	22	24	42	15	44			64			84		
5	40	15	25	31	00	45			65			85		
6	39	37	26	41	11	46			66			86		
7	41	20	27	37	40	47			67			87		
8	41	00	28	42	20	48			68			88		
9	** 37	81	29	39	08	49			69			89		
10	42	64	30	41	10	50			70			90		
TOTAL	399	50	TOTAL	378	42	TOTAL			TOTAL			TOTAL		
Joint Number	LENGTH		Joint Number	LENGTH		Joint Number	LENGTH		Joint Number	LENGTH		Joint Number	LENGTH	
11	40	31	31	40	00	51			71	Joints on lease not included		91		
12	40	13	32	39	06	52			72	in tally		92		
13	36	00	33	33	82	53			73	42	20	93		
14	41	10	34	35	89	54			74	39	95	94		
15	40	25	35	41	49	55			75	42	92	95		
16	42	24	36	40	92	56			76	42	35	96		
17	43	97	37			57			77	39	44	97		
18	39	92	38			58			78			98		
19	40	57	39			59			79			99		
20	41	25	40			60			80			100		
TOTAL	405	74	TOTAL	231	18	TOTAL			TOTAL			TOTAL		

TALLY SUMMARY

GROUP NO.	LENGTH		JTS	LENGTH	
1-10	399	50	200	7918	51
11-20	405	74	36	1402	84
21-30	378	42			
31-40	231	18			
41-50					
51-60					
61-70					
71-80					
81-90					
91-100					
TOTAL	1414	84			

BROUGHT FORWARD	
PAGE TOTAL	
TOTAL ON LOCATION	
TOTAL LEFT OUT (incl. L.J.)	
TOTAL PERMANENTLY IN HOLE	

* Left out

** Damaged

(Note transfer of left out joints to where and by whom.)

REMARKS: (Use separate page for each weight, grade or thread.)

NOTE: Pipe measured with threads on. Deduct .33 ft/jt or 12 feet. Total this page 1402.84

Tallied by J. Dortch

D&S PETROLEUM CONSULTANTS LTD.

TUBULAR TALLY

73F 4

WELL: COLUMBIA ET AL KOTANEELEE YT H38 DATE: Oct 15 1977

Size: 7" Weight: 29 #/Ft. Thread: Butt Grade: N-80 Make:

Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
1	41 92	21	42 55	41	40 25	61	44 49	81	* 44 77
2	42 61	22	42 01	42	40 74	62	41 79	82	* 41 68
3	33 21	23	36 95	43	39 50	63	42 63	83	* 41 12
4	40 30	24	41 28	44	41 93	64	40 18	84	* 40 47
5	41 18	25	40 21	45	40 97	65	42 05	85	* 39 32
6	35 38	26	42 02	46	41 28	66	41 07	86	* 41 38
7	35 10	27	39 04	47	38 18	67	32 56	87	* 42 68
8	41 51	28	42 88	48	40 84	68	42 71	88	* 41 41
9	37 58	29	42 70	49	43 08	69	* 41 50	89	* 37 05
10	40 35	30	39 26	50	41 32	70	29 78	90	* 39 85
TOTAL	389 14	TOTAL	408 90	TOTAL	408 09	TOTAL	408 76	TOTAL	409 73
Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
11	43 50	31	41 84	51	41 66	71	31 08	91	44 85
12	39 00	32	45 25	52	34 55	72	45 30	92	29 91
13	39 95	33	45 26	53	43 22	73	43 07	93	42 06
14	38 78	34	41 26	54	41 08	74	33 41	94	44 88
15	40 95	35	45 35	55	45 02	75	33 64	95	40 09
16	39 85	36	44 12	56	42 20	76	* 39 69	96	41 22
17	42 54	37	42 80	57	41 00	77	* 37 07	97	41 23
18	41 22	38	34 10	58	38 45	78	* 37 03	98	31 78
19	40 38	39	44 35	59	40 78	79	* 33 82	99	42 39
20	41 57	40	42 02	60	42 36	80	* 40 63	100	41 74
TOTAL	407 74	TOTAL	426 35	TOTAL	410 32	TOTAL	374 74	TOTAL	400 15

TALLY SUMMARY

GROUP NO.	LENGTH	JTS	LENGTH	
1-10	389 14	300	9321	35
11-20	407 74	100	4008	51
21-30	408 90			
31-40	426 35			
41-50	408 09		13329	86
51-60	410 32			
61-70	408 76			
71-80	374 74			
81-90	409 73			
91-100	400 15			
TOTAL	4043 92			

BROUGHT FORWARD

PAGE TOTAL

TOTAL ON LOCATION

TOTAL LEFT OUT (incl. L.J.)

TOTAL PERMANENTLY IN HOLE

* Left out

** Damaged

(Note transfer of left out joints to where and by whom.)

REMARKS: (Use separate page for each weight, grade or thread.)

NOTE: Pipe measured with threads on. Deduct 4.25"/jt or 35.41'. Total threads off 4008.51'

Tallied by

D&S PETROLEUM CONSULTANTS LTD.

TUBULAR TALLY

73F 4

WELL: COLUMBIA ET AL KOTANEELEE YT H38 DATE: Oct 15 1977

Size: 7" Weight: 29 #/Ft. Thread: Butt Grade: N-80 Make:

Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
1	40 94	21		41		61		81	
2	42 48	22		42		62		82	
3	36 45	23		43		63		83	
4	34 27	24		44		64		84	
5	41 21	25		45		65		85	
6	36 94	26		46		66		86	
7	39 20	27		47		67		87	
8	** 35 48	28		48		68		88	
9	** 27 03	29		49		69		89	
10	40 67	30		50		70		90	
TOTAL	374 67	TOTAL		TOTAL		TOTAL		TOTAL	
Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
11	37 53	31		51		71		91	
12	37 32	32		52		72		92	
13	30 81	33		53		73		93	
14	33 20	34		54		74		94	
15	31 18	35		55		75		95	
16	46 24	36		56		76		96	
17		37		57		77		97	
18		38		58		78		98	
19		39		59		79		99	
20		40		60		80		100	
TOTAL	216 28	TOTAL		TOTAL		TOTAL		TOTAL	

TALLY SUMMARY

GROUP NO.	LENGTH	JTS	LENGTH	
1-10	374 67	400	13329 86	BROUGHT FORWARD
11-20	216 28	16	585 29	PAGE TOTAL
21-30				TOTAL ON LOCATION
31-40			1131 38	TOTAL LEFT OUT (incl. L.J.)
41-50			12783 77	TOTAL PERMANENTLY IN HOLE
51-60				
61-70				
71-80				
81-90				
91-100				
TOTAL	590 95			

* Left out

** Damaged

(Note transfer of left out joints to where and by whom.)

REMARKS: (Use separate page for each weight, grade or thread.)

NOTE: Pipe measured with threads on. Deduct 4.25"/jt or 5.66 feet. Total threads off 585.29

Tallied by J. Dortch

BIT RECORD

&S PETROLEUM CONSULTANTS LTD.

WELL NAME: COLUMBIA ET AL KOTANEELEE YT H38

OPERATOR:

CONTRACTOR:

DATE _____ MO./DAY/YEAR

SPUDDED April 6, 1977 A.M./P.M.

SET SURFACE (20") April 23, 1977 - 771' XX./P.M.

UNDER SURFACE 13 3/8" June 21/77 - 3023' XXX/P.M.

UNDER INTER 9 5/8" Sept 15/77 10850' XXX/P.M.

COMPLETION 7" Oct 19/77 12789' A.M./XXX

RELEASE October 21, 1977 XX./P.M.

		OD	ID
DRILL PIPE	SIZE		
DRILL COLLARS	SIZE		
TOOL JOINTS	SIZE	5	
		EH	

TYPE

PUMP No. 1

PUMP No. 2

NO	SIZE	MAKE	TYPE	JET SIZE	SERIAL NO.	DEPTH OUT	FEET	HOURS	ACCUM. HOURS	BIT CONDITION			NO OF D.C.	WT. 1000 LBS.	RPM	PUMP PRESS	NO. 1		NO. 2		MUD	
																	SPM	LINER	SPM	LINER	WT	VIS
1	17 1/2	HW	OSCIG	2-16,1-13	BA195	369	369	25	25.00	4	2	1	15	5/10	80/130	1100	62	6½			8.8	38
2	17 1/2	HW	OSCIG	2-16,1-13	BH 646	502	133	16 1/2	41.50	3	5	1	"	5/10	80/130	"	"	"			8.8	35
3	12 1/4	HW	XIG	3-15	8337	892	390	45 3/4	87.25	4	2	1	"	5	70	"	"	"			8.9	32
4	12 1/4	HW	XIG	3-15	6601	970	78	7	94.25				"	10	40	"	"	"			8.9	32
5	17 1/2	HW	OSCIG	3-17	705434	1005	35	11 3/4	106.00	4	3	3	"	"	70	300	"	"			9.0	45
6	12 1/4	HW	XIG	3-14	8340	1140	135	10 1/4	116.25	4	2	1	"	25	70/50	1400	"	"			9.0	44
7	12 1/4	SEC	M44L	3-14	205908	1193	53	15 1/4	131.50	3	2	1	"	10/20	65	1700	60	"			9.0	35
8	12 1/4	SEC	M44L	3-14	705853	1239	46	15 1/4	146.75	3	2	1	14	10	60	1000	"	"			9.6	35
9	12 1/4	SMITH	4JS	3-14	PH 107	1363	124	24 1/4	171.00	3	1	1	"	20	38/44	1400	"	"			9.6	38
10	12 1/4	SMITH	3JS	3-14	774HP	1498	135	45	216.00	5	2	1	"	20/40	32/45	1300	"	"			9.7	40
11	12 1/4	SMITH	F-5	3-14	351HW	1780	282	67 1/4	283.25	5	2	1	"	25	40	"	"	"			10.1	40
12	12 1/4	SMITH	F-5	3-14	285JC	1987	207	64 3/4	348.00	6	2	1	"	35	44	"	"	"			10.1	40
13	12 1/4	SMITH	F-6	3-13	102FP	2268	281	92 1/2	417.50	8	4	1	"	35	45	1800	"	"			10.2	41
14	12 1/4	SMITH	F-6	3-13	637EW	2390	122	37 1/4	482.25	6	2	0	"	28	44	"	"	"			10.2	40
15	12 1/4	SMITH	F-7	3-13	181FX	2558	168	42	524.25	4	2	0	"	30	45	"	"	"			10.1	45
16	12 1/4	SMITH	F-7	3-13	993EK	2823	265	86 1/4	597.50	8	4	0	"	30	45	"	"	"			10.1	45
17	12 1/4	SEC	H-88	3-13	680528	3023	198	63 1/4	660.75	8	3	0	"	35	45	"	"	"			10.3	40
18	12 1/4	SEC	M-88	2-14,1-13	195595	3076	53	17 3/4	678.50	8	2	0	"	35	45	1600	"	"			9.7	38

73F6

RUNS TO OPEN HOLE FROM 12 1/4" to 17 1/2"

D&S PETROLEUM CONSULTANTS LTD.

BIT RECORD

WELL NAME: COLUMBIA ET AL KOTANEELEE YT H38

OPERATOR:

CONTRACTOR:

DATE _____ MO./DAY/YEAR

SPUDDED April 6, 1977 A.M./P.M.

SET SURFACE (20") April 23, 1977 - 771' XX.M./P.M.

UNDER SURFACE 13 3/8" June 21/77 - 3023' XXX/P.M.

UNDER INTER 9 5/8" Sept 15/77 10850' XXX/P.M.

COMPLETION 7" Oct 19/77 12789' A.M./XXX

RELEASE October 21, 1977 XX./P.M.

	OD	ID
DRILL PIPE SIZE		
DRILL COLLARS SIZE		
TOOL JOINTS SIZE	5	
	EH	

TYPE

PUMP No. 1

PUMP No. 2

NO	SIZE	MAKE	TYPE	JET SIZE	SERIAL NO.	DEPTH OUT	FEET	HOURS	ACCUM. HOURS	BIT CONDITION			NO OF D.C.	WT. 1000 LBS.	RPM	PUMP PRESS	NO. 1		NO. 2		MUD	
																	SPM	LINER	SPM	LINER	WT	VIS
1	17½		HO 3pt	open	85257	1144	139	20 1/4	20 1/4	3	3	1	13	25	38	850	60	6½	60	6½	10.2	41
2	17½		HO 3pt	open	X5469	1449	305	62 1/4	82 1/2	8	4	1	13	25	35	300	60	6½			10.2	38
3	17½		HO 3pt	open	X5572	1563	114	21 1/2	104	4	2	1	13	25	38	300	60	6½			10.0	36
4	17½		HO 3pt	open	X5572	1646	83	37 1/4	141 1/4	6	8	0	15	35	35	300	60	6½			10.2	38
5	17½		HO 3pt	open	X5469	1703	26 1/4		167 1/2	4	6	1	15	35	38	1000	60	6½			10.2	38
6	17½		Y72	3-16	615645	1793	90	28	195 1/2	3	3	1	15	30	35	1000	60	6½			10.0	38
7	17½		Y72	3-16	616398	1936	143	32 3/4	228 1/4	2	3	1	15	25	40	900	60	6½			10.2	40
8	17½		4JS	3-16	BV657	2179	243	46 1/2	274 3/4	6	4	0	15	30	40	700	60	6½			10.4	44
9	17½		HO	3-18	10583	2272	93	21 3/4	296 1/2	2	4	1	15	35	38	700	60	6½			10.3	45
10	17½		HO	3-18,3-12	10013	2415	143	31 1/2	328	2	6	1	15	30	38	700	60	6½			10.3	42
11	17½		44R	2-16,1-15	6M656	2415	damaged															
12	17½		HW	2-16,1-15	HM914	2528	113	36 1/4	364 1/4	7	4	0	14	30	35	1000	60	6½			10.4	39
13	17½		HO	conv	X5567	2596	68	26 1/4	390	2	8	1	14	30	35	1200	60	6½			10.2	42
14	17½		H8	1-16,2-14	526281	2803	207	42 1/2	432 1/2	8	4	1	14	30	35	1200	60	6½			10.3	39
15	17½		H8	1-16,2-14	526068	2999	196	42 1/2	474 3/4	7	8	1	14	30	35	1200	60	6½			10.4	40
16	17½		4JS	1-16,2-14	EF523	3023	24	4 3/4	479 1/2				14	30	35	1200	60	6½			10.4	40

73F6

D&S PETROLEUM CONSULTANTS LTD.

BIT RECORD

WELL NAME: COLUMBIA ET AL KOTANEELEE YT H38

OPERATOR:

CONTRACTOR:

DATE _____ MO./DAY/YEAR

SPUDDED April 6, 1977 A.M./P.M.

SET SURFACE (20") April 23, 1977 - 771' XX./P.M.

UNDER SURFACE 13 3/8" June 21/77 - 3023' XXX/P.M.

UNDER INTER 9 5/8" Sept 15/77 10850' XXX/P.M.

COMPLETION 7" Oct 19/77 12789' A.M./XXX

RELEASE October 21, 1977 XX./P.M.

		OD	ID
DRILL PIPE	SIZE		
DRILL COLLARS	SIZE		
TOOL JOINTS	SIZE	5	
		EH	

TYPE

PUMP No. 1

PUMP No. 2

NO	SIZE	MAKE	TYPE	JET SIZE	SERIAL NO.	DEPTH OUT	FEET	HOURS	ACCUM. HOURS	BIT CONDITION			NO OF D.C.	WT. 1000 LBS.	RPM	PUMP PRESS	NO. 1		NO. 2		MUD	
																	SPM	LINER	SPM	LINER	WT	VIS
19	12¼	Sec	H88	2-14,1-13	719090	3200	124	29	707 1/2	8	3	0	14	35	35	1600	60				9.5	37
20	12¼	Sec	H88	2-14,1-13	720438	3270	70	14 3/4	722 1/4	8	2	1	20	45	35	1600	60				9.4	36
21	12¼	Sec	H100	2-14,1-13	678428	3414	144	44 1/2	766 3/4	4	2	1	20	40	35	1500	60				9.3	39
22	12¼	Sec	H100	2-13,1-15	710046	3594	180	57 3/4	824 1/2	4	2	1	20	35	45	1500	60				9.3	41
23	12¼	Sec	M89F	2-13,1-15	741470	3654	60	17 1/4	841 3/4	8	1	1	20	35	45	1500	60				9.3	44
24	12¼	Smith	F6	2-13,1-15	519FW	3727	73	22	863 3/4	6	1	1	20	30	45	1500	60				9.2	39
25	12¼	Reed	S72J	2-13,1-14	109390	3798	71	26 1/4	890	8	1	1	20	30	30	1600	60				9.2	38
26	12¼	Smith	F6	2-14,1-13	788FW	3900	102	49 3/4	939 3/4	8	2	1	20	30	30	1500	60				9.2	37
27	12¼	Sec	M88	2-13,1-15	554968	4200	300	70¼	1010	8	2	1	20	30	65	1500	60				9.2	41
28	12¼	Sec	H77	2-13,1-15	683608	4233	33	12 1/2	1022 1/2	4	2	1	20	25	80	1500	60				9.2	39
29	12¼	Smith	F4	1-12,13,16	379JT	4621	388	76 3/4	1099 1/4	5	2	1	20	30	45	1400	62				9.3	41
30	12¼	Reed	FP62	2-13,1-15	532222	5143	522	90 3/4	1190	5	7	1	20	40	50	1500	62				9.4	47
31	12¼	Sec	S88	2-13,1-15	645453	5266	123	28	1218	3	1	1	20	35	50	1500	62				9.4	43
32	12¼	Smith	F4	2-13,1-15	705JP	5788	522	65 1/2	1283 1/2	5	2	1	20	30	30	1500	60				9.4	46
33	12¼	Reed	FP63	2-13,1-14	601199	5840	52	14 3/4	1301 1/4	2	1	1	20	35	60	1500	62				9.4	48
34	12¼	Sec	M44N	2-13,1-15	652339	6245	405	48 3/4	1350	5	2	1/8	20	50	60	1500	60				9.5	47
35	12¼	Smith	3JS	2-13,1-14	495TC	7175	930	105	1455	7	4	1	20	40	60	1550	60				9.4	40
36	12¼	Smith	F2	3-14	VT664	7337	162	26 1/4	1481.1/4	2	8	1	20	30	60	1600	60				9.4	42

73F6

BIT RECORD

WELL NAME: COLUMBIA ET AL KOTANEELEE YT H38

OPERATOR:

CONTRACTOR:

3S PETROLEUM CONSULTANTS LTD.

DATE _____ MO./DAY/YEAR

SPUDDED April 6, 1977 A.M./P.M.

SET SURFACE (20") April 23, 1977 - 771' XM./P.M.

UNDER SURFACE 13 3/8" June 21/77 - 3023' XM./P.M.

UNDER INTER 9 5/8" Sept 15/77 10850' XM./P.M.

COMPLETION 7" Oct 19/77 12789' A.M./PM

RELEASE October 21, 1977 XM./P.M.

		OD	ID
DRILL PIPE	SIZE		
DRILL COLLARS	SIZE		
TOOL JOINTS	SIZE	5	
		EH	

TYPE

PUMP No. 1

PUMP No. 2

NO	SIZE	MAKE	TYPE	JET SIZE	SERIAL NO.	DEPTH OUT	FEET	HOURS	ACCUM. HOURS	BIT CONDITION			NO OF D.C.	WT. 1000 LBS.	RPM	PUMP PRESS	NO. 1		NO. 2		MUD	
																	SPM	LINER	SPM	LINER	WT	VIS
37	12¼	Reed	FP52	2-13,1-14	330203	7707	370	66 1/4	15475	6	6	2	20	35	55	1400	60	6½			9.3	41
38	12¼	Smith	F3	2-13,1-14	302CJ	7852	145	18 1/4	1565 3/4	8	2	0	20	35	55	1550	60	6½			9.3	45
33RR	12¼	Reed	FP63	2-13,1-14	601199	7920	120	30 1/2	1596 1/4	3	2	1	20	40	55	1550	60	6½			9.8	45
39	12¼	Reed	FP62	2-13,1-14	734477	8120	210	42 3/4	1639	6	2	1	20	50	55	1550	60	6½			9.8	41
40	8 15/32	Chris. Diam.	open		7E067	8169	35	7	1646	6	2	1	20	14	66	800	44	6½			9.9	45
41	12¼	Sec	S88	2-13,1-15	570796	8193	59	9 3/4	1655 3/4	2	1	1	20	55	50	1550	60	6½			9.9	45
42	12¼	Smith	2JS	2-13,1-14	818CT	8631	438	54 1/2	1710 1/4	7	5	0	20	60	55	1650	60	6½			9.8	45
43	12¼	Smith	3JS	2-14,1-13	780HP	9200	569	61	1771 1/4	4	6	1	20	55	55	1650	60	6½			9.9	46
44	12¼	Reed	FP52	2-14,1-13	320200	9310	110	35 1/2	1806 3/4	4	8	1	20	60	60	1650	60	6½			10.0	48
45	12¼	Sec	M44N	2-13,1-14	652530	9617	307	43 1/2	1850 1/4	4	3	1	20	60	60	1650	60	6½			9.7	45
46	12¼	Smith	3JS	2-13,1-14	434HH	9813	196	47	1897 1/4	2	3	1	20	60	60	1650	60	6½			9.7	45
47	12¼	Sec	M44N	2-13,1-14	625064	10135	322	47 3/4	1945	5	7	1	20	60	60	1650	60	6½			9.7	45
48	12¼	Sec	M44N	2-13,1-15	758258	10403	268	40 1/2	1985 1/2	8	5	0	20	50	60	1550	60	6½			9.7	41
49	12¼	Smith	F3	2-13,1-14	828JF	10677	274	31 1/2	2014	4	2	0	20	50	60	1550	60	6½			9.8	42
50	12¼	Sec	M44N	2-13,1-15	758309	10850	173	33	2050	5	1	1	20	60	60	1550	60	6½			9.7	40
51	8½	Reed	S136	3-11	303981	10920	70	12 1/4	2062 1/4	8	6	0	21	30	50	1500	58	5½			9.6	40
52	8½	Sec	M44N	3-11	571346	11025	105	22 1/4	2084	8	4	1	21	35	55	1375	60	5½			9.6	40
53	8½	Reed	FP52	3-11	NSY378	11255	230	58	2142	2	3	1	21	35	55	1500	60	5½			9.9	40

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D&S PETROLEUM CONSULTANTS LTD.

BIT RECORD

WELL NAME: COLUMBIA ET AL KOTANEELEE YT H38

OPERATOR:

CONTRACTOR:

DATE _____ MO./DAY/YEAR

SPUDDED April 6, 1977 A.M./P.M.

SET SURFACE (20") April 23, 1977 - 771' XX./P.M.

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UNDER INTER 9 5/8" Sept 15/77 10850' XXX/P.M.

COMPLETION 7" Oct 19/77 12789' A.M./XXX

RELEASE October 21, 1977 XX./P.M.

		OD	ID
DRILL PIPE	SIZE		
DRILL COLLARS	SIZE		
TOOL JOINTS	SIZE	5	
		EH	

TYPE

PUMP No. 1

PUMP No. 2

NO	SIZE	MAKE	TYPE	JET SIZE	SERIAL NO.	DEPTH OUT	FEET	HOURS	ACCUM. HOURS	BIT CONDITION			NO OF D.C.	WT. 1000 LBS.	RPM	PUMP PRESS	NO. 1		NO. 2		MUD	
																	SPM	LINER	SPM	LINER	WT	VIS
54	8 1/2	Reed	S136	3-11	304284	11362	107	17 1/2	2159.5	6	2	1	21	30	55	1500	60	5½			9.9	36
55	8 1/2	Sec	M44N	3-11	627265	11422	60	13 1/2	2173	4	1	1	21	30	55	1500	60	5½			9.9	36
56	8 1/2	SM	3JS	3-11	350KK	11654	232	48 1/2	2226	4	1	1	21	30	55	1500	60	5½			9.8	37
57	8 1/2	Reen	FP 62	3-11	301951	11690	36	2 3/4	2228 3/4	1	1	1	21	30	55	1500	60	5½			9.9	37
58	8 15/32	Christ. Dia	open		7E067	11750	60	20	2248 3/4	1	1	1	21	22	65	1300	55	5½			9.9	37
57RR	8 1/2	Reed	FP62	3-11	3-1951	11890	190	11 1/2	2260 1/4	3	3	1	21	30	55	1300	55	5½			10.0	37
59	8 1/2	Reed	FP62	3-11	137808	12040	150	10 3/4	2271	2	2	1	21	26	50	1400	60	5½			9.8	37
58RR	8 15/32	Christ Dia	open		7E067	12064	24	5 3/4	2276 3/4	1	1	1	20	19	65	1200	55	5½			10.0	38
59RR	8 1/2	Reed	FP62	2-11,1-10	237808	12260	196	12 3/4	2285 1/2	4	3	1	21	35	55	950	60	5½			10.0	36
58RR	8 15/32	Christ Dia	open		7E067	12220	60	6 3/4	2292 1/4	1	1	1	21	19	65	1150	60	5½			9.9	36
60	8 1/2	Smith	F4	3-14	806KP	12450	130	9 1/4	2301 1/2	2	1	1	21	35	55	1150	60	5½			9.9	36
58RR	8 15/32	Christ Dia	open		7E067	12510	60	7 3/4	2309 1/4	1	1	1	20	20	60	1350	60	5½			10.0	42
60RR	8 1/2	Smith	F4	3-14	806KP	12708	198	22 3/4	2349	7	2	1	21	35	55	1300	60	5½			10.0	42
58RR	8 15/32	Christ Dia	open		7E067	12789	34	10 1/4	2367 1/2	good			21	20	55	1300	60	5½			10.0	46

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COLUMBIA ET AL KOTANEELEE YT H38

MUD REPORT

PRODUCT TYPE	AMOUNT USED	UNIT
Milbar	4370	100# sx
Milgel	1553	100# sx
Sawdust	220	40# sx
Caustic	447	50# sx
KCl	5602	50# sx
Bicarb	26	100# sx
IPI 37	434	50# sx
Soda Ash	4	100# sx
Cyfloc	79	50# sx
Milfree	0	gal
LD-8	40	gal
Unical	85	50# sx
Kwikseal	0	50# sx
Lime	90	50# sx
Staflo	94	50# sx
Noxygen	558	50# sx
XC Polymer	146	50# sx
AltoSol	177	gal
Ami Tec	115	gal
Milgard	103	50# sx

D&S PETROLEUM CONSULTANTS LTD.

DEVIATION SURVEY SUMMARY

73F 7 COLUMBIA ET AL KOTANEELEE YT H38

DEPTH	DEGREES	DEPTH	DEGREES
100	1 1/8	1404	1 3/4
195	1/2	1470	1 7/8
280	1	1500	1 3/4
310	1 1/4	1560	1 7/8
340	1	1690	1 3/4
360	1 1/4	1750	1 7/8
400	1 3/4	1815	1 7/8
450	1 1/4	1875	2
460	1 1/2	1938	2 1/8
495	1 7/8	2000	2 1/2
525	1 3/4	2060	2 1/4
550	1 1/4	2125	2 1/4
585	1 1/8	2185	2 3/8
615	1 1/4	2265	2 3/4
645	1 3/4	2345	3
685	1 1/2	2390	2 1/2
725	1 1/4	2435	2 7/8
750	1 7/8	2500	3 1/4
780	1 3/4	2558	2 7/8
815	1 3/4	2628	3 1/4
845	2	2684	3
875	2	2748	3
970	1 3/4	2823	2 7/8
995	2 1/2	2903	3
1050	2 1/2	3021	3
1111	2 1/2	3060	3 1/2
1140	2 3/4	3074	3 7/8
1170	2 1/2	3185	3 1/4
1210	2 1/2	3326	4
1250	2 3/4	3389	4
1280	2	3484	4 3/4
1310	2 1/4	3560	4 1/4
1340	2 1/2	3611	5 3/4
1373	1 7/8	3642	5 1/2

D&S PETROLEUM CONSULTANTS LTD.

DEVIATION SURVEY SUMMARY

73F 7

DEPTH	DEGREES	DEPTH	DEGREES
3654	5	4850	6 3/4
3691	6	4910	6 1/2
3719	6 1/8	4976	6 1/2
3727	6	5035	6 1/2
3764	5 5/8	5070	6 1/4
3798	6 1/2	5102	6 1/2
3815	6	5140	6 1/2
3850	6	5225	7N 16W
3888	6	5350	8N 0W
3920	6	5415	8 1/4N 4E
3950	6 1/2	5470	8 1/2N 0E
3975	6 1/2	5530	8 1/3N 1E
4012	7	5600	8 1/4N 2E
4040	7	5660	8 1/4N
4070	7 1/8	5760	misrun
4100	7 5/8	5780	7 3/4
4130	7 3/4	5820	7 1/4 N 2W
4165	8 1/2	5885	7N 4W
4195	9	5940	7N 12W
4225	8	6040	7N 12W
4230	8	6100	6 7/8N 15W
4263	8	6175	7N 15W
4290	8 3/4	6220	7N 17W
4325	8 1/4	6290	6 3/4N 18W
4353	8 1/4	6345	7N 21W
4415	8 1/4	6410	7 1/3N 19W
4478	8 1/2	6475	7N 23W
4528	8 3/4	6535	7 1/4N 21W
4620	9	6600	7N 21W
4690	8	6660	7 1/2N 25W
4725	8	6725	7 3/4N 26W
4785	7 3/4	6785	7N 24W

D&S PETROLEUM CONSULTANTS LTD.

DEVIATION SURVEY SUMMARY

73F 7

DEPTH	DEGREES	DEPTH	DEGREES
6850	6 3/4N 20W	10120	5
6910	7 1/4N 24W	10403	4 3/4
6970	7 1/2N 22W	10677	4 1/2N 49W
7035	7 1/2N 23W	10840	4 1/2
7095	7 3/4N 24W	10920	3 7/8
7160	8 1/8N 28W	11025	5
7225	8N 29W	11254	6
7290	8 1/4N 28W	11362	6 1/2
7115	8 3/4N 28W	11422	6 3/4
7475	8 1/2N 29W	11654	6 1/4
7535	8 1/4N 28W	12040	misrun
7700	7 1/4N 32W	12260	6 1/2
7600	7 1/2N 32W	12450	7 1/4
7790	7 1/4N 32W		
7870	6 1/2N 32W		
7940	6 3/4N 40W		
8030	6 1/4N 42W		
8120	6 1/4		
8160	6N 45W		
8255	5 1/2N 48W		
8325	5N 50W		
8475	4 3/4N 50W		
8620	4		
8750	4 1/4N 36W		
8910	3 3/4N 31W		
9100	3 3/4N 41W		
9230	3 3/4N 43W		
9290	3 1/2N 43W		
9490	2 3/4N 48W		
9610	5		
9740	4 1/2N 85W		
9950	4 1/4N 40W		

COLUMBIA GAS DEVELOPMENT OF CANADA LTD. PAGE

COLUMBIA ET AL KOTANEELEE YT H-38 DATE OF SURVEY OCTOBER 28, 197

WILDCAT VERTICAL SECTION DIRECTION CLOSURE

YUKON TERRITORY 32 DEG EAST CORRECTION APPLIE

MAGNETIC DIRECTIONAL SINGLE SHOT

UNITED DIRECTIONAL DRILLING LTD

RECORD OF SURVEY

MEASURED DEPTH	TRUE VERTICAL DEPTH	SUB SEA TVD	COURSE INCLINATION DEG MIN	COURSE DIRECTION DEG	DOG-LEG SEV DEG/100	TOTAL RECTANGULAR COORDINATES NORTH/SOUTH	EAST/WEST	VERTICAL SECTION
3023	3023.00	773.00	ASSUMED VERTICAL TO 3023			0. N	0. E	0.
3125	3124.95	874.95	3 0	N 86 W	2.94	.19 N	2.66 W	1.85
3219	3218.78	968.78	4 0	N 88 W	1.07	.47 N	8.39 W	5.75
3313	3312.52	1062.52	4 30	N 78 W	.95	1.35 N	15.28 W	10.85
3407	3406.20	1156.20	5 0	N 78 W	.53	2.97 N	22.89 W	16.97
3500	3498.88	1248.88	4 30	N 73 W	.70	4.88 N	30.34 W	23.22
3594	3592.55	1342.55	5 0	N 68 W	.69	7.49 N	37.67 W	29.93
3688	3686.16	1436.16	5 30	N 73 W	.72	10.35 N	45.78 W	37.32
3782	3779.73	1529.73	5 30	N 78 W	.51	12.60 N	54.49 W	44.64
3876	3873.19	1623.19	6 48	N 83 W	1.49	14.21 N	64.42 W	52.25
3969	3965.54	1715.54	6 48	N 70 W	1.65	16.77 N	75.06 W	61.04
4063	4058.81	1808.81	7 30	N 78 W	1.29	19.95 N	86.29 W	70.69
4157	4151.89	1901.89	8 30	N 73 W	1.30	23.25 N	98.93 W	81.34
4251	4244.83	1994.83	8 45	N 78 W	.84	26.77 N	112.57 W	92.80
4345	4337.77	2087.77	8 30	N 68 W	1.62	30.86 N	126.01 W	104.56
4438	4429.69	2179.69	9 0	N 76 W	1.41	35.20 N	139.44 W	116.50
4532	4522.60	2272.60	8 30	N 73 W	.72	39.01 N	153.22 W	128.27
4626	4615.57	2365.57	8 30	N 63 W	1.57	44.19 N	166.05 W	140.48
4720	4708.60	2458.60	8 0	N 53 W	1.61	51.28 N	177.46 W	153.25
4814	4801.80	2551.80	7 0	N 56 W	1.14	58.42 N	187.44 W	165.13
4907	4894.12	2644.12	7 0	N 38 W	2.35	66.06 N	195.63 W	176.24
5001	4987.44	2737.44	6 48	N 22 W	2.05	75.73 N	201.24 W	187.26
5015	5001.35	2751.35	6 45	N 18 W	3.39	77.28 N	201.80 W	188.81
5110	5095.69	2845.69	6 45	N 20 W	.25	87.84 N	205.44 W	199.23
5225	5209.86	2959.86	7 0	N 16 W	.47	100.92 N	209.68 W	211.99
5350	5333.80	3083.80	8 0	N 0 E	1.84	116.95 N	211.78 W	225.63
5415	5398.15	3148.15	8 15	N 4 E	.95	126.12 N	211.45 W	232.45
5470	5452.57	3202.57	8 30	N 0 E	1.15	134.12 N	211.18 W	238.41
5530	5511.92	3261.92	8 20	N 1 E	.37	142.91 N	211.10 W	245.09

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COLUMBIA FT AL KOTANEELEE YT H-38 DATE OF SURVEY OCTOBER 28, 197

WILDCAT VERTICAL SECTION DIRECTION CLOSUR

YUKON TERRITORY 32 DEG EAST CORRECTION APPLIE

MAGNETIC DIRECTIONAL SINGLE SHOT

UNITED DIRECTIONAL DRILLING LTD

RECORD OF SURVEY

MEASURED DEPTH	TRUE VERTICAL DEPTH	SUB SEA TVD	COURSE INCLINATION DEG MIN	COURSE DIRECTION DEG	DOG-LEG SEV DEG/100	TOTAL RECTANGULAR COORDINATES NORTH/SOUTH	EAST/WEST	VERTICAL SECTION
5660	5640.57	3390.57	8 15	N 0 E	.48	161.60 N	210.69 W	259.16
5780	5759.40	3509.40	7 45	N 0 E	.42	178.30 N	210.69 W	271.97
5820	5799.06	3549.06	7 15	N 2 W	1.41	183.52 N	210.78 W	276.03
5885	5863.56	3613.56	7 0	N 4 W	.54	191.57 N	211.20 W	282.47
5940	5918.15	3668.15	7 0	N 12 W	1.77	198.20 N	212.13 W	288.14
6040	6017.40	3767.40	7 0	N 12 W	.01	210.12 N	214.66 W	298.91
6100	6076.96	3826.96	6 53	N 15 W	.63	217.16 N	216.35 W	305.40
6175	6151.41	3901.41	7 0	N 15 W	.16	225.92 N	218.70 W	313.62
6220	6196.08	3946.08	7 0	N 17 W	.54	231.19 N	220.21 W	318.63
6290	6265.57	4015.57	6 45	N 18 W	.40	239.18 N	222.73 W	326.37
6345	6320.18	4070.18	7 0	N 21 W	.80	245.39 N	224.93 W	332.54
6410	6384.67	4134.67	7 20	N 19 W	.64	253.01 N	227.70 W	340.16
6475	6449.16	4199.16	7 0	N 23 W	.92	260.57 N	230.60 W	347.83
6535	6508.70	4258.70	7 15	N 21 W	.59	267.47 N	233.38 W	354.90
6600	6573.20	4323.20	7 0	N 21 W	.38	275.00 N	236.27 W	362.53
6660	6632.72	4382.72	7 30	N 25 W	1.18	281.96 N	239.23 W	369.77
6725	6697.14	4447.14	7 45	N 26 W	.44	289.75 N	242.95 W	378.12
6785	6756.65	4506.65	7 0	N 24 W	1.32	296.72 N	246.21 W	385.57
6850	6821.18	4571.18	6 45	N 20 W	.83	303.93 N	249.13 W	392.96
6910	6880.73	4630.73	7 15	N 24 W	1.16	310.70 N	251.87 W	399.92
6970	6940.24	4690.24	7 30	N 22 W	.60	317.79 N	254.88 W	407.29
7035	7004.68	4754.68	7 30	N 23 W	.20	325.63 N	258.13 W	415.38
7095	7064.15	4814.15	7 45	N 24 W	.47	332.93 N	261.30 W	423.02
7160	7128.53	4878.53	8 8	N 28 W	1.03	340.99 N	265.24 W	431.73
7225	7192.88	4942.88	8 0	N 29 W	.30	349.01 N	269.59 W	440.67
7290	7257.23	5007.23	8 15	N 28 W	.44	357.08 N	273.98 W	449.67
7415	7380.86	5130.86	8 45	N 28 W	.40	373.40 N	282.65 W	467.75
7475	7440.18	5190.18	8 30	N 29 W	.49	381.31 N	286.94 W	476.57
7535	7499.54	5249.54	8 15	N 28 W	.48	388.98 N	291.11 W	485.13
7600	7563.92	5313.92	7 30	N 32 W	1.43	396.70 N	295.55 W	493.90

COLUMBIA GAS DEVELOPMENT OF CANADA LTD. PAGE
COLUMBIA ET AL KOTANEELEE YT H-38 DATE OF SURVEY OCTOBER 28, 197
WILDCAT VERTICAL SECTION DIRECTION CLOSUR
YUKON TERRITORY 32 DEG EAST CORRECTION APPLIE
MAGNETIC DIRECTIONAL SINGLE SHOT

UNITED DIRECTIONAL DRILLING LTD
RECORD OF SURVEY

MEASURED DEPTH	TRUE VERTICAL DEPTH	SUB SEA TVD	COURSE INCLINATION DEG MIN	COURSE DIRECTION DEG	DOG-LEG SEV DEG/100	TOTAL RECTANGULAR COORDINATES NORTH/SOUTH	EAST/WEST	VERTICA SECTIO
7700	7663.10	5413.10	7 15	N 32 W	.25	407.59 N	302.35 W	506.6
7790	7752.38	5502.38	7 15	N 32 W	0.	417.22 N	308.37 W	517.8
7870	7831.80	5581.80	6 30	N 32 W	.94	425.34 N	313.45 W	527.3
7940	7901.34	5651.34	6 45	N 40 W	1.36	431.85 N	318.19 W	535.3
8030	7990.76	5740.76	6 15	N 42 W	.61	439.54 N	324.87 W	545.5
8120	8080.22	5830.22	6 15	N 43 W	.12	446.77 N	331.49 W	555.3
8160	8119.99	5869.99	6 0	N 45 W	.82	449.84 N	334.45 W	559.6
8255	8214.52	5964.52	5 30	N 48 W	.61	456.39 N	341.35 W	569.0
8325	8284.22	6034.22	5 0	N 50 W	.76	460.60 N	346.18 W	575.3
8475	8433.68	6183.68	4 45	N 50 W	.17	468.79 N	355.94 W	587.9
8620	8578.26	6328.26	4 0	N 42 W	.67	476.41 N	363.92 W	598.9
8750	8707.92	6457.92	4 15	N 36 W	.38	483.68 N	369.79 W	608.2
8910	8867.53	6617.53	3 45	N 31 W	.38	492.96 N	375.97 W	619.3
9100	9057.13	6807.13	3 45	N 41 W	.34	502.97 N	383.24 W	631.6
9230	9186.85	6936.85	3 45	N 43 W	.10	509.29 N	388.93 W	640.1
9290	9246.73	6996.73	3 30	N 43 W	.42	512.07 N	391.52 W	643.9
9490	9446.38	7196.38	3 15	N 48 W	.19	520.32 N	399.90 W	655.6
9610	9566.07	7316.06	5 0	N 46 W	1.46	526.23 N	406.19 W	664.2
9740	9695.62	7445.62	4 30	N 45 W	.39	533.78 N	413.87 W	674.9
9950	9905.01	7655.01	4 15	N 40 W	.22	545.56 N	424.70 W	690.9
10120	10074.45	7824.45	5 0	N 45 W	.50	555.63 N	433.98 W	704.6
10403	10356.43	8106.43	4 45	N 45 W	.09	572.63 N	450.99 W	728.5
10677	10629.54	8379.54	4 30	N 45 W	.09	588.25 N	466.61 W	750.5
10840	10792.03	8542.03	4 30	N 45 W	0.	597.30 N	475.65 W	763.3
10920	10871.82	8621.82	3 53	N 45 W	.77	601.43 N	479.79 W	769.1
11025	10976.50	8726.50	5 0	N 45 W	1.06	607.18 N	485.54 W	777.2
11254	11204.44	8954.44	6 0	N 45 W	.44	622.70 N	501.06 W	799.1
11362	11311.80	9061.80	6 30	N 45 W	.46	631.02 N	509.37 W	810.8
11422	11371.40	9121.40	6 45	N 45 W	.42	635.91 N	514.27 W	817.7

COLUMBIA GAS DEVELOPMENT OF CANADA LTD.
COLUMBIA ET AL KOTANELEE YT H-38
WILDCAT
YUKON TERRITORY
MAGNETIC DIRECTIONAL SINGLE SHOT

DATE OF SURVEY OCTOBER 28, 1977
VERTICAL SECTION DIRECTION CLOSURE
32 DEG EAST CORRECTION APPLIED

UNITED DIRECTIONAL DRILLING LTD
RECORD OF SURVEY

MEASURED DEPTH	TRUE VERTICAL DEPTH	SUB SEA TVD	COURSE INCLINATION DEG MIN	COURSE DIRECTION DEG	DOG-LEG SEV DEG/100	TOTAL RECTANGULAR COORDINATES NORTH/SOUTH	EAST/WEST	VERTICAL SECTION
12040	11985.61	9735.61	6 15	N 45 W	.00	684.20 N	562.55 W	885.73
12260	12204.25	9954.25	6 30	N 45 W	.11	701.47 N	579.83 W	910.07
12450	12392.89	10142.89	7 15	N 45 W	.39	717.55 N	595.91 W	932.72
12789	12729.18	10479.18	7 15	N 45 W	0.	747.80 N	626.16 W	975.34

** THE CALCULATIONS ARE BASED ON THE MINIMUM RADIUS OF CURVATURE METHOD **

THIS SURVEY WAS CALCULATED BY MACHINE COMPUTER UTILIZING PROGRAM FURNISHED BY SPERRY-SUN WELL SURVEYING COMPANY, HOUSTON, TEXAS. CALCULATIONS ARE BASED, HOWEVER, UPON INPUT DATA FURNISHED BY THE CUSTOMER WHO ASSUMES RESPONSIBILITY AND HOLDS SPERRY-SUN WELL SURVEYING COMPANY HARMLESS FROM LIABILITY.

HORIZONTAL DISPLACEMENT = 975.34 FEET AT NORTH 39 DEG. 56 MIN. WEST (TRUE)

START OF SURVEY WAS 2250.00 FEET ABOVE SEA LEVEL

Note: 1) The well bore is assumed vertical to 3023'M.D. for calculation purposes. Drift angle surveys only were conducted in this portion of the well bore and its' exact position cannot be determined in this calculation.

2) The direction of all surveys below 9950' has been extrapolated on a North-45°-West bearing. It is assumed drift angle surveys only were conducted below this depth, and that the direction of the well bore remained relatively constant in the North/West quadrant.

D&S PETROLEUM CONSULTANTS LTD.

DAILY OPERATIONS REPORT

73F 8

WELL : COLUMBIA GAS ET AL KOTANEELEE YT H-38

DATE	DEPTH	DETAIL OF OPERATION
1977		
Apr. 7	189'	189' SPUDDED at 4:00 p.m. April 6, 1977 with 17 1/2" bit. Repaired mud line at 8:00 a.m. Drilling ahead, very rough. Surveys:- 111'-1/8° Mud Wt. 8.7, Vis. 30.
Apr. 8	369'	180' Pull out bit number 1. Surveys:- 195'-1/8°, 280'-1°, 310'-1 1/4° 340'-1°, 360'-1 1/4°, Mud Wt. 8.7, Vis. 40.
Apr. 9	495'	126' Drilling 17 1/2" surface. Stabilize 60' above bit. Will change to 12 1/4" bit. Surveys:- 400'-1 3/4°, 430'-1 1/4°, 460'-1 1/2°, Mud Wt. 8.9, Vis. 35.
Apr.10	663'	168' Drilling 12 1/4" from 495'. Surveys:- 495'-1 7/8°, 525'-1 3/8°, 550'-1 1/4°, 585'-1 1/8°, 615'-1 1/4°, 645'-1 3/4°, Mud Wt. 8.9, Vis. 38.
Apr.11	807'	144' Drilling 12 1/4" from 495'. Have near bit three point reamer, blade stabilizer at 30' and non-rotating stabilizer at 90'. Surveys:- 685'-1 1/2°, 725'-1 1/4°, 750'-1 7/8°, 780'-1 3/4°, Mud Wt. 8.9, Vis. 36.
Apr.12	943'	136' Drilling 12 1/4" hole. Will ream out and run casing. Surveys:- 815'-1 3/4°, 845'-2°, 875'-2°, 930'-2°, Mud Wt. 8.8, Vis. 32.
Apr.13	970'	27' Reaming to 17 1/2" at 915' (420'). Drilled 12 1/4" to 970'. Reamed 12 1/4" to 17 1/2" from 495-915'. Surveys:- 840'-1 3/4°. Mud Wt. 8.8, Vis. 37.
Apr.14	970'	- Reaming 17 1/2" to 26" at 400'. Reamed 12 1/4" to 17 1/2" 915-970' (55') - 2 hours. Reamed 17 1/2" to 26" 50-400' (350') - 14 1/2 hours. Surveys:- 970'-1 3/4°, Mud Wt. 9.0, Vis. 40.
Apr.15	970'	- Reaming 17 1/2" to 26" at 560'. Surveys:- 425'-2°, Mud Wt. 9.3, Vis. 37.
Apr.16	970'	- Reaming 17 1/2" to 26" at 592'. Reamed 17 1/2" to 26" 50-577' (527') Checked hole openers. Lost cutters. Ran in with 11 1/4" magnet. No recovery. Mud Wt. 9.3, Vis. 37.
Apr.17	970'	- Reamed 17 1/2" to 26" at 592'. Twist off 6 1/4" drill collar at 218' K.B. Waiting on fishing tools. Ran in with overshot and recovered collars and hole openers. Ran 17 1/2" bit. Clean out to 863'.
Apr.18	970'	- Fishing for hole opener cutters. Ran in with 11 1/2" magnet - recovered three bearing rollers. Ran in with magnet, recovered hub from

D&S PETROLEUM CONSULTANTS LTD.

DAILY OPERATIONS REPORT

73F 8

WELL : COLUMBIA GAS ET AL KOTANEELEE YT H-38

DATE	DEPTH	DETAIL OF OPERATION
		cutter. Ran in with magnet, no recovery. Ran in with 16 7/8" junk
		basket, center cut mill shoe. Worked four hours, no recovery. Cut
		cones off 12 1/4" bit. Worked junk in hole. Ran in with magnet,
		recovered four bearing rollers. Ran in with magnet, no recovery.
		Mud Wt. 8.8, Vis. 31.
Apr.19	970'	- Ran in with 12 1/4" bit without cones. Stirred up junk. Ran in with
		11 1/2" magnet - no recovery. Ran in with 17 1/2" bit. Ran in with
		magnet and junk sub, recovered one bearing roller. Ran in with poor
		boy basket, recovered one hole opener cutter and one hub. Ran in
		with magnet and junk sub, recovered two bearing rollers. Ran in with
		poor boy basket, recovered two hole opener cutters. Ran in with 17½"
		bit. Ran in with poor boy basket - recovered one cutter hub.
Apr.20	970'	- Ran 17 1/2" bit, cleaned to bottom. Some iron on bottom. Ran in
		with 26" hole opener. Opened hole (592-650') - 68 feet. Mud Wt. 8.9,
		Vis. 37.
Apr.21	970'	- Preparing to run 20" casing to 771'. Reamed 17 1/2" hole to 26" hole
		650-771' (121'). Pulled out of hole - checked reamer. Reamer badly
		cracked. Ran in with 17 1/2" bit. Cleaned to bottom 970'. 26" hole
		to 771'. Going to run pipe. Mud Wt. 9.2, Vis. 38.
Apr.22	972'	2' Running 20" conductor casing. Made four runs with 11 1/2" magnet.
		Recovered two main cutter pins, roller bearing and ball bearing. Made
		two bit runs. Drilled 2' of 17 1/2" hole. Hole appears clean of all
		iron. Circulated and conditioned hole to run 20" casing. Mud Wt. 9.2,
		Vis. 38.
Apr.23	972'	- Waiting on cement on 20" casing. Ran 19 joints, 20", 94#, H-40
		Buttress casing, Baker float shoe and Davis float collar, 3 centralizers
		welded shoe and float collar. Total string length 772.99'. Landed at
		772' K.B. Pressure tested lines to 2000#. Prewash 20 barrels. Mixed
		1500 cu.ft. Oilwell "G" + 2% $CaCl_2$. Cemented to surface. Displaced
		with 13 barrels H_2O. Float held. Cement slurry avg. 15.2#/gal. No
		indication of lost circulation. Cement in place at 7:15 p.m. April 22,
		1977.
Apr.24	972'	Running in with drill pipe to pressure test BOPs, etc. Welded on 20"
		casing bowl. Pressure tested weld to 1500 psi with grease gun and marsh

D&S PETROLEUM CONSULTANTS LTD.

DAILY OPERATIONS REPORT

73F 8

WELL : COLUMBIA GAS ET AL KOTANEELEE YT H-38

DATE	DEPTH	DETAIL OF OPERATION
		gauge. Held OK. Installed 20" hydril and blowdown manifold and flare
		line.
Apr.24	972'	- Ran in with 17 1/2" bit to cement at 723'. Pressure tested hydril
		and blowdown manifold to 1000 psi for 15 minutes - held OK. Pressure
		tested kelly cock - held OK. Activated motor shut-offs - OK. Flare
		lines, poor boy degasser and Swaco degassers hooked up. Seven hours
		drilling out cement and shoe. Mud Wt. 9.2, Vis. 39.
Apr.26	1135'	163' Drilling 12 1/4" hole. Drilled 17 1/2" from 972-1005'. Drilled
		12 1/4" from 1005-1135'. Surveys:- 995'-2 1/2°, 1050'-2 1/2°, 1111'-2½°
		Mud Wt. 9.2, Vis. 39.
Apr.27	1193'	58' Tripping for cracked and washed out drill collar (7"). Limestone,
		pyrite, siltstone. Water flow 20 barrels per hour. Gas - 100 unit
		background. Surveys:- 1142'-2 3/4°, 1172'-2 1/2°, Mud Wt. 9.1, Vis. 36.
Apr.28	1239'	46' Tripping to sonoscope collars and change bit. One cracked drill
		collar (7½") and XO sub (7½ to 6¼). Hard limestone. 240 units
		background gas. Surveys:- 1210'-2 1/2°, 1239'-2 1/2°, Mud Wt. 9.6, Vis.
		37.
Apr.29	1337'	98' Drilling 12 1/4" hole. Background gas - 10 units. Limestone and
		siltstone. Surveys:- 1250'-2 3/4°, 1280'-2°, 1310'-2 1/4°, Mud Wt. 9.6
		Vis. 39.
Apr. 30	1393'	56' Drilling 12 1/4" hole. Siltstone, dense chert. Background - 5 units.
		Surveys:- 1540' -2 1/2°, 1373' - 17/8°, Mud Wt 9.7, visc. 38
May 1	1466'	73' Drilling 12 1/4" hole. Dense chert - 5 units of background.
		surveys:- 1404' -1 3/4° Mud Wt. 9.9, visc. 47
May 2	1557'	91' Drilling 12 1/4" hole. Drilling chert and siltstone. 5 units
		background gas. Surveys:- 1470' -1 7/8° 1500' -1 3/4°. Mud Wt. 9.8
		Visc. 37
May 3	1660'	103' Drilling 12 1/4" hole. Firm chert, siltstone, hard shale
		Background gas 25 units. Surveys:-1560-1 7/8°. Mud Wt. 9.8, visc 37.
May 4	1738'	78' Drilling 12 1/4" hole. Matsen sand, sandstone. 3 units background
		gas. Raining, lease very wet. Surveys:- 1690- 1 3/4°. Mud wt. 9.8
		visc. 39.

D&S PETROLEUM CONSULTANTS LTD.

DAILY OPERATIONS REPORT

WELL: COLUMBIA GAS ET AL KOTANEELEE YT H-38

73F 8

DATE	DEPTH	DETAIL OF OPERATION
May 5	1804'	66' Drilling 12 1/4" hole. 15 units background gas. Drilling in sandstone. Surveys:- 1751'-1 7/8°. Mud wt. 9.8, visc 41
May 6	1882'	78' Drilling 12 1/4" hole. Matsen - no change in samples. 10 units background. 9.8 mud weight required to holdback water flow. Raining, roads wet. Surveys:- 1815'-1 7/8°, mud wt. 9.8, viscosity 37
May 7	1956'	74' Drilling 12 1/4" hole. 15 units background gas. Surveys:- 1875'-2°, 1938'- 2 1/8° Mud wt. 9.8, viscosity 40.
May 8	2017'	61' Drilling 12 1/4" hole. Matsen sand, 3 units background gas. Surveys 2000'-2 1/2°. Mud wt. 10.2, viscosity 38.
May 9	2083'	66' Drilling 12 1/4" hole. 4 units background gas. Surveys 2066'-2 1/4°. Mud wt. 10.2, viscosity 38.
May 10	2158'	75' Drilling 12 1/4" hole. Matsen sand. 10 units background gas. Surveys:- 2125'-2 1/4°. Mud weight 10.2, viscosity 38.
May 11	2238'	80' Drilling 12 1/4" hole. Matsen sand. 10 units background gas. Surveys:- 2185' - 2 3/8° Mud weight 10.2, viscosity 38
May 12	2280'	42' Drilling 12 1/4" hole. Matsen sand - 10 units background gas. Trip for bit. Turned 2 pins on near bit reamer. Turned 3 pins in up hole reamer. Shock sub OK. Surveys:- 2265'- 2 3/4°. Mud wt. 10.2 viscosity 41.
May 13	2365'	85' Drilling 12 1/4" hole. Matsen sand. 8 units background gas. Surveys:- 2345'-3°. Mud wt. 10.2, viscosity 40.
May 14	2430'	65' Drilling 12 1/4" hole. Matsen sand. 5 units background gas. Surveys:- 2390'-2 1/2°. Mud wt. 10.2, viscosity 40
May 15	2523'	93' Drilling 12 1/4" hole. Matsen sand. 30 units background gas. surveys:- 2435'-2 7/8°, 2500'-3 1/4°. Mud wt. 10.2, viscosity 38
May 16	2586'	63' Drilling 12 1/4" hole. Matsen sand, 45 units background gas. surveys:- 2558'-2 7/8°. Mud wt. 10.2, viscosity 38
May 17	2650'	64' Drilling 12 1/4" hole. Matsen sand. BGG 30. Surveys:- 2628'-3 1/4°, mud wt. 10.1, viscosity 36.
May 18	2720'	70' Drilling 12 1/4" hole. Matsen sand. 20 units background gas. Surveys:-2684'-3°, mud wt. 10.2, viscosity 38

D&S PETROLEUM CONSULTANTS LTD.

DAILY OPERATIONS REPORT

73F 8

WELL : COLUMBIA GAS ET AL KOTANEELEE YT H-38

DATE	DEPTH	DETAIL OF OPERATION
May 19	2800'	80' Drilling 12 1/4" hole. Mattson sand. 20 units background gas.
		Surveys:- 2748' -3°. Mud wt. 10.2, viscosity 38
May 20	2852'	52' Drilling 12 1/4" hole. Mattson sand. 20 units background gas.
		Surveys:- 2823'- 2 7/8°. Mud wt 10.2, viscosity 40
May 21	2927'	75' Drilling 12 1/4" hole. Mattson sand, 5 units background gas.
		Surveys:- 2903'-3°. Mud wt. 10.1, viscosity 38
May 22	3000'	73' Drilling 12 1.4" hole.. Mattson sand. 3 units background gas.
		Snowing. Panels, one man, one tool to come. Waiting on weather.
		Mun wt. 10.2, viscosity 38.
May 23	3021'	21'. Logging, ran DILL, BHC, SGC and CNL-FDC logs. Surveys:3021'-3°
		Mud wt. 10.3, viscosity 40
May 24	3021'	nil Open 12 1/4" to 17 1/2" with hole opener. 1005' - 1105' (100')
		Sent logs in with Schlumberger. Weather, rain and snow. Mud wt 10.2
		viscosity 38.
May 25	3021'	nil Open 12 1/4" to 17 1/2" with hole opener, from 1105' - 1226' (121')
		Mud wt. 10.2, viscosity 41
May 26	3021'	nil Open 12 1/4" to 17 1/2" with hole opener from 1226' - 1326' (100')
		Weather- sunny and mild. Mud wt. 10.2, viscosity 41
May 27	3021'	nil Open 12 1/4" hole to 17 1/2" with hole opener from 1336' - 1449'
		(113') Weather: clear and mild. Mud wt. 10.2, viscosity 39
May 28	3021'	nil Open 12 1/4" to 17 1/2" with hole opener from 1449' - 1562' (113')
		Weather - clear & mild, Mud wt. 10.2, viscosity 38
May 29	3021'	nil Reaming 12 1/4" to 17 1/2" hole, from 1562' - 1598' (36')
		Weather, cloudy but dry. Mud wt. 10.0, viscosity 36
May 30	3021'	nil Reaming 121/4" hole to 17 1/2" from 1598' - 1659' (61')
		Weather, raining. Mud wt. 10.2, viscosity 38
May 31	3021'	nil Reaming 12 1/4" to 17 1/2", from 1659' - 1703' (44') Weather -
		raining, mud wt. 10.2, viscosity 38
June 1	3021'	nil Reaming 12 1/4" hole to 17 1/2", from 1703' - 1745' (42')
		Sonoscoped collars and subs, OK. Weather, raining. Mud wt. 10.2,
		viscosity 38

D&S PETROLEUM CONSULTANTS LTD.

DAILY OPERATIONS REPORT

WELL: COLUMBIA GAS ET AL KOTANEELEE YT H38

73F8

DATE	DEPTH	DETAIL OF OPERATION
June 2	3021'	nil. 8:00 am, tripping. Reamed 12 1/4" to 17 1/2" hole with 17 1/2"
		bit from 1745' - 1793' (48'). Made two trips to check for wash out
		in drill string. Bit washed out between the cones. Mud wt. 10.0,
		viscosity 38
June 3	3021'	nil. Reaming 12 1/4" to 17 1/2" hole with 17 1/2" bit. Reamed from
		1793' - 1900' (107') Drill string: Bit, SS, NRS, 60' - 9" collars,
		NRS. Weather - fogged in. Mud wt. 10.2, viscosity 42
June 4	3021'	nil Reaming 12 1/4" hole to 17 1/2" with 17 1/2" bit. Reamed from
		1900' - 2000'. (100') Weather - clearing. Surveys: 1900' - 2 1/4°
		1975' - 1 7/8°. Mud wt. 10.2, viscosity 40
June 5	3021'	Reaming 12 1/4" hole to 17 1/2" with 17 1/2" bit, from 2000' - 2100'
		(100'). Weather: good. Surveys: 2032' - 2 1/8°. Mud wt. 10.2,
		viscosity 38
June 6	3021'	Reaming 12 1/4" to 17 1/2" with 17 1/2" bit, from 2100' - 2115'. (15')
		Weather- clear and warm. Mud wt. 10.2, viscosity 39
June 7	3021'	Reaming 12 1/4" to 17 1/2" hole, from 2115' - 2222' (107') Weather:
		clear and warm. Surveys: 2128' - 2 1/2°. Mud wt. 10.4, viscosity 44.
June 8	3021'	Reaming 12 1/4" hole to 17 1/2" from 2222' to 2292' (70') Weather;
		clouding over. Mud wt. 10.3, viscosity 45
June 9	3021'	Reaming 12 1/4" hole to 17 1/2" from 2292' - 2405' (113') Weather:
		cloudy and dry. Mud wt. 10.3, viscosity 42
June 10	3021'	8:00 a.m. Waiting on collar thread inspector. Tripped for hole opener
		#11, while running in had to clean hole from 1139'-1250' and 1600'-1671'
		Twisted off pin on change over between drill pipe and 6 1/4" collars,
		6 5/16" drill collar looking up. Bit 3 stands off bottom. Pulled out
		of hole, ran in with 10 5/8" O.S. and 6 3/8" grapple. Tagged fish
		approx. 240' lower. Picked up fish in O.S., worked fish in tight hole,
		recovered same. Bit belled and shock sub damaged. Will check collars
		& replace sub prior to running back in hole. Mud wt 10.3, visc 42.
June 11	3021'	Checked drill collars, layed down 2-9", 1-7" &2 cracked XO subs, picked
		up 3-6 1/4" drill collars. 8:00 a.m., running in hole. Mud wt 10.3
		viscosity 42.

D&S PETROLEUM CONSULTANTS LTD.

DAILY OPERATIONS REPORT

COLUMBIA GAS ET AL

KOTANEELEE YT H38

73F 8

WELL :

DATE	DEPTH	DETAIL OF OPERATION
June 12	3021'	Reaming 12 1/4" to 17 1/2" from 2415' - 2455' (40') Running in with
		bit #12, had to ream from 1641'-1700' and from 1924'-2180'. Severe
		torquing through these sections. Bottom section could be caused by
		undergauge hole. 5 feet fill on bottom. Mud wt. 10.3, visc. 42
June 13	3021'	8:00 a.m. Tripping. Reamed 12 1/4" to 17 1/2" from 2455'-2528' (73')
		Mud wt 10.4, viscosity 39
June 14	3021'	Reaming 12 1/4" to 17 1/2" from 2528'-2583 (55') Mud wt 10.2, visc 43
June 15	3021'	Reaming 12 1/4" to 17 1/2" from 2583'-2628'(45') Tripped to check for
		washout - rubber in shock sub washed out. Mud wt. 10.2, visc. 42
June 16	3021'	Tripping for wash out. Reamed 12 1/4" to 17 1/2" from 2628'-2738'(110')
		Mud wt. 10.3, visc. 40
June 17	3021'	Reaming 12 1/4" to 17 1/2" from 2738'-2819' (81')
		Found wash out in shock sub. 1.6 miles road gravel, 0.5 to go.
		Mud wt. 10.3, viscosity 39
June 18	3021'	Reaming 12 1/4" to 17 1/2" from 2819' - 2936' (117')
		Surveys: 2820'-3 1/2°, 2890'-3 1/2°
June 19	3023'	Circulating and conditioning hole. Reamed 12 1/4" to 17 1/2" from
		2936' - 3023' (87') Mud weight 10.4, viscosity 40
June 20	3023'	Circulated and conditioned hole to run 13 3/8" surface casing. Rig to
		and run 76 joints 13 3/8" 72# Buttress Baker float shoe and collar.
		Thread lok and weld shoe, collar, and first 2 joints. Welded on
		centralizers. Total casing run 3022.54. Preparing to cement
June 21	3023'	Waiting on cement. Surface casing. Mixed and pumped 2500 sacks
		Portland Neat. Pressure tested lines to 2000 psi. 20 barrels water
		ahead, followed by 17 barrels 11.5lbs/gal Scavenger. Cement weight
		15.2-15.6 lbs/gal, displaced drill pipe with 54 barrels water,back
		wash drill pipe. Floats held. Cement to surface. Annulus held OK.
		Casing landed at 3020'. Cement in place 9:00 pm June 20.
June 22	3023'	Cut off casing, remove 20" hydrill, install 13 3/8" OCT casing head.
		Pressure tested seals to 3000 psi through test port. Install pipe
		gate, double gate, and hydril (13 3/8 x 5000)

D&S PETROLEUM CONSULTANTS LTD.

DAILY OPERATIONS REPORT

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WELL : COLUMBIA ET AL KOTANEELEE YT H38

DATE	DEPTH	DETAIL OF OPERATION
June 23	3023'	Headed up BOP stack. Pressure test Pipe rams, blind rams and manifold to 5000 psi for 15 minutes. Pressure tested hydril to 2000 psi. Check motor chut offs. Drilled 1" holes in matting and grouted with 400 sacks cement. Preparing to run in with bit and pressure test casing.
June 24	3060'	Drilling 12 1/4" hole. Ran in with 12 1/4" bit, tagged cement top at 2960', pressure tested casing to 3500 psi (OK), pressure tested lower pipe rams, kill line, kelly values to 2000 psi (OK). Drilled out to 3033', ran bleed off test (data attached). Drilled ahead. Background gas 3 units. Mattson sand formation. Mud wt. 10.1, Vis 38
June 25	3102'	42' Drilling 12 1/4" hole. Surveys 3060'-3 1/2°, 3074'-3 7/8° Mud weight 9.7, Viscosity 38
June 26	3200'	98' Drilling 12 1/4" hole and tripping for bit change. Surveys: 3185'-3 1/4°, mud weight 9.5, viscosity 37
June 27	3265'	65' Drilling 12 1/4" hole with packed drilling assembly. Produced 100 barrels while tripping, after starting drilling making 6 barrels per hour. 7/10 mile of road to gravel. Surveys: 3185'-3 1/4° Mud wieght 9.2, viscosity 35
June 28	3325'	Drilling 12 1/4" hole. Grouted 250 sacks under matting, levelling rig with jacking crew. Mud weight 9.4, viscosity 36
June 29	3390'	65' Drilling 12 1/4" hole. 6 units background gas. Mattson sand. Grouted matting and leveled rig. Surveys:- 3326'-4°, 3389'-4° Mud weight 9.3, viscosity 37
June30	3443'	53' Drilling 12 1/4" hole. 5 units background gas. Mattson sand. Surveys:- 3389'-4°, mud weight 9.3, viscosity 39
July 1	3519'	76' Drilling 12 1/4" hole. 5 units background gas. Mattson sand. 90% Sandstone, 10% Siltstone. Surveys:- 3484'-4 3/4°, mud weight 9.2 viscosity 38
July 2	3588'	69' Drilling 12 1/4" hole, 5 units background gas. Mattson sand. Sandstone 60%, Siltstone 20%, Shale 20%. Surveys:-3564'-4 1/4°
July 3	3645'	57' Drilling 12 1/4" hole. 5 units background gas. Mattson sand. Sandstone 10%, Siltstone 80%, Shale 10%, Surveys:- 3611'-5 3/4° 3642'-5 1/2 ° Mud weight 9.3, visc 41

D&S PETROLEUM CONSULTANTS LTD.

DAILY OPERATIONS REPORT

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WELL : COLUMBIA ET AL KOTANEELEE YT H38

DATE	DEPTH	DETAIL OF OPERATION
July 4	3715'	70' Drilling 12 1/4" hole. 3 units background gas. Mattson sand.
		Surveys:- 3642'-5 1/2°, 3654'-5°, 3691'-6° Mud weight 9.3, visc 44
July 5	3751'	36' Drilling 12 1/4" hole. 5 units background gas. Mattson sand.
		Sandstone 10%, Siltstone 40%, Shale 30%, Limestone 20%,
		Surveys:- 3719'-6 1/8°, 3727'-6°. Mud wt 9.2, visc 39
July 6	3801'	50' Drilling 12 1/4" hole, 2 units background gas. Mattson sand.
		80% sandstone, 10% Siltstone, 10% Shale. Surveys:- 3764'-5 5/8°
		3798'-6 1/2°, mud weight 9.2, viscosity 38
July 7	3845'	44' Drilling 12 1/4" hole. 2 units background gas. Mattson sand.
		20% Sandstone, 40% Siltstone, 30% Shale. Surveys:-3815'-6°
		Mud wt. 9.2, visc. 37
July 8	3899'	54' Drilling 12 1/4" hole. 5 units background gas. Mattson sand.
		Shale 90%, Dolomite 10%. Surveys:- 3850'-6°, 3888'-6°, mud wt 9.2
		Visc. 37
July 9	3957'	58' Drilling 12 1/4" hole, 4 units background gas. Mattson sand.
		Sandstone 60%, Siltstone 40%. Surveys:- 3920'-6°, 3950'- 6 1/2°.
July 10	4037'	80' Drilling 12 1/4" hole. 4 units background gas. May be coming out
		of mattson sand. Shale 70%, Siltstone 20%, Lime 10%.
		Surveys 3975' - 6 1/2°, 4012' - 7°, mud wt. 9.2, visc. 35
July 11	4149'	112' Drilling 12 1/4" hole, 5 units background gas. 70 units connec-
		tion gas. Sandstone 90%, mixed 10%. Surveys:- 4040' - 7°,
		4070'-7 1/8°, 4100'-7 5/8°, 4130'-7 3/4°. Mud wt. 9.2, visc 39
July 12	4223'	74' Drilling 12 1/4" hole. 3 units background gas. Lower Mattson
		Flett transition. Shale 40%, Siltstone 40%, Sandstone 20%.
		Surveys:- 4165'-8 1/2°, 4195' - 9°, mud wt. 9.2, visc 41
July 13	4330'	107' Drilling 12 1/4" hole. 10 units background gas. Mattson-Flett
		Transition. 40% Shale, 60% Siltstone. Surveys:- 4225'-8°, 4263'-8°,
		4290'-8 3/4°, 4325'-8 1/4°. Mud wt. 9.2, visc. 39
July 14	4460'	130' Drilling 12 1/4" hole. 15 units background gas. Mattson-
		Flett transition. 10% Shale, 50% Siltstone, 40% Sandstone.
		Surveys:-4353'-8 1/4°, 4415'-8 1/4°. Mud wt. 9.4, visc. 42

D&S PETROLEUM CONSULTANTS LTD.

DAILY OPERATIONS REPORT

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WELL : COLUMBIA ET AL KOTANEELEE YT H38

DATE	DEPTH	DETAIL OF OPERATION
July 15	4540'	80' Drilling 12 1/4" hole. 5 units background gas. 60% Siltstone 50% Shale Surveys:- 4478'-8 1/2°. Mud wt. 9.3, Viscosity 41
July 16	4621'	81' Drilling 12 1/4" hole. Running in bit #30. 5 units background gas. Siltstone 80%, Shale 10%, Sandstone 10%. Surveys:- 4528'-8 3/4° 4620' - 9°. Mud wt. 9.3, viscosity 41
July 17	4700'	79' Drilling 12 1/4" hole. 10 units background gas. 100% Siltstone Surveys:-4690' - 8°. Mud wt. 9.4, visc. 40
July 18	4792'	92' Drilling 12 1/4" hole. 5 units background gas. 40% Siltstone 30% Sandstone, 10% Limestone, 20% Dolomite. Surveys:-4725' - 8° 4785' - 7 3/4°. Mud wt. 9.4, Viscosity 38
July 19	4946'	154' Drilling 12 1/4" hole. 35 units background gas. Shale 20%, Siltstone 40%, Silty Sandstone 30%, Sandstone 10%. Surveys:- 4850' - 6 3/4°, 4910' - 6 1/2° Mud wt. 9.3, viscosity 40
July 20	5113'	167' Drilling 12 1/4" hole. 20 units background gas. Shale 70%, Siltstone 30%, Surveys:- 4976' - 6 1/2°, 5035' - 6 1/2°, 5070' - 6 1/4° 5102' - 6 1/2°. Mud wt. 9.3, visc. 44
July 21	5221'	108' Drilling 12 1/4" hole. 25 units background gas. At 5110' - 6 3/4° N 52°W with displacement 226.35 N 66° 57'W. Made directional survey on trip. 60% Shale, 20% Siltstone, 20% Sandstone. Surveys:-5140'-6 1/2° Mud wt. 9.4, visc 47
July 22	5266'	45' Drilling 12 1/4" hole. Tripping for bit. 5 units background gas. Shale 80%, Siltstone 20%. Surveys:- 5225' - 7°N 16°W. Mud wt. 9.3, visc 47
July 23	5466'	200' Drilling 12 1/4" hole. Background gas 50 units, formation shale 100%. Surveys:- 5350' - 8°N 0W 5415' - 8 1/4°N 4°W Mud wt. 9.4 visc. 42
July 24	5624'	158' Drilling 12 1/4" hole. Background gas 15 units. Flett top 5606' 100% Shale. Surveys:- 5470' 8 1/2°N 0E, 5530' - 8 1/3°N 1°E 5600' - 8 1/4°N 2°E Mud wt. 9.5, visc 44
July 25	5770'	146' Drilling 12 1/4" hole. Background gas 8 units. 5624' - 5710' 100% Shale 5710' - 5750' 50% Dolomite 50% Shale. Mud wt. 9.4, visc. 40

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DAILY OPERATIONS REPORT

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WELL : COLUMBIA ET AL KOTANEELEE YT H38

DATE	DEPTH	DETAIL OF OPERATION
July 26	5834'	64' Drilling 12 1/4" hole. 10 units background gas. Formation
		Flett 100% Shale. Surveys:- 5780' - 7 3/4°, 5820' - 7 1/4°N 2°W
		Mud wt. 9.4, viscosity 46
July 27	5980'	146' Drilling 12 1/4" hole. 22 units background gas. No caving
		this trip. Shale 90% Limestone 10%. Surveys:- 5885' - 7°N 4°W
		5940' - 7°N 12°W Mud wt. 9.4, visc. 48
July 28	6155'	170' Drilling 12 1/4" hole. 10 units background gas. Shale 80%,
		Siltstone 10%, Marl 10%. Slight caving occurring. Surveys:- 6040'
		7°N 12°W, 6100' - 6 7/8°N 15°W. Mud wt. 9.5, visc. 49
July 29	6245'	90' Run in with new bit. Change shock sub and jars. 10 units
		background gas. 100% Shale, some caving. Surveys:- 6175' - 7°N 15°W
		6220' - 7°N 17°W, Mud wt. 9.5, visc. 47
July 30	6440'	195' Drilling 12 1/4" hole. 10 - 12 units background gas. 100% Shale
		Cavings slight to good. surveys:- 6290' - 6 3/4°N, 18°W, 6345' - 7°N
		21°W, 6410' - 7 1/3°N 19°W. Mud wt 9.5, visc 49
July 31	6635'	195' Drilling 12 1/4" hole. Background gas 10 units. 95% Shale,
		5% Limestone. surveys:- 6475' - 7°N 23°W, 6535' - 7 1/4°N 21°W
		6600' - 7°N 21°W Mud wt. 9.4, visc 39
Aug 1	6830'	195' Drilling 12 1/4" hole. 20 units background gas. Shale 75%
		Limestone 20%, Marl 5%. 6245 - 6770 - 20% Chert Surveys: - 6660' -
		7 1/2°N 25°W, 6725' - 7 3/4°N 26°W 6785' - 7°N 24°W Mud wt. 9.4
		visc. 40
Aug 2	7020'	Footage 190' Drilling 12 1/4" hole 22 units background gas. Shale
		60% Limestone 10% Siltstone 10%, Marl 20%. Surveys:- 6850' - 6 3/4° N
		20°W, 6910' - 7 1/4°N 24°W, 6970' - 7 1/2°N 22°W Mud wt. 9.3, visc 41
Aug 3	7175'	155' Tripping out with bit. 30 units background gas. Shale 90%
		Limestone 5% Marl 5%. Surveys:- 7035'-7 1/2°n 23°W 7095'-7 3/4°n 24°W
		7160'-8 1/8°N 28°W Mud wt. 9.3, viscosity 38

D&S PETROLEUM CONSULTANTS LTD.

DAILY OPERATIONS REPORT

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WELL : COLUMBIA ET AL KOTANEELEE YT H38

DATE	DEPTH	DETAIL OF OPERATION
1977		
Aug 13	7992'	Footage 72'. Drilling 12¼" hole, Flowline temp 52.6°C, drilling exponent 1.79, Bulk Density 2.66, Total gas 3 units, background gas 25 units, Limestone 50%, Shale 40%, Dolomite 5%, Marl trace, Chert trace. Surveys: 7940'-6 3/4°M 40°W, Mud wt 9.8, viscosity 39
Aug 14	8120'	Footage 128'. Drilling 12 1/4" hole. Flowline temp 55.7°C, Drilling Exp. 1.74, Bulk Density 2.63, Background gas 23 units, total gas 9 units, Shale 70%, Limestone 30%, weather clear Surveys:-8030'-6¼°N 42°W, Mud wt. 9.8, viscosity 41
Aug 15	8130'	Footage 10' drilled 12¼"hole to 8130', pulled and picked up core barrel Drop table bushing locking pin down hole while installing pipe wiper. Ran in with 11" magnet and Junk Sub. No recovery. Running in with bit and junk sub. Flowline temp 55°C, drilling exponent 1.64, Cuttings gas 7 units, background gas 22 units, shale density 2.67, Shale 75% Limestone 25% Surveys:- 8120'-6¼°
Aug 16	8169'	Footage 39' Recovering core #1, core dia 4", bit OD 8 15/32", ran in with tooth bit and junk sub, drilled 4' hole, worked pipe and pump and recover most of fish. Ran back in hole to cut core #1, 8134'-8169' (35') recover ed 100%. Flowline temp 120°F, drilling exponent 1.33, Shale density 2.6, cuttings gas 4 units, background gas 40 units, Shale 90%, Limestone 5%, Marl 5%. Surveys:-8160'-6°N 45°W, mud wt. 9.9, visc 45
Aug 17	8192'	Footage 23'. Lay down core barrel, runin with 12 1/4" bit, ream rat hole 8134'-8169' (35') drill ahead 12¼" hole. Flowline temp 52.9°C., Drilling exponent 2.0, Shale density 2.6, cuttings gas 4 units, back ground gas 30 units, Shale 90%, Limestone 5%, Marl 5%, Surveys:-8160'-6°N 45°W, Mud wt. 10.0, viscosity 44
Aug 18	8282'	Footage 90'. Drilling 12¼" hole, Flowline temp 54.1°C, drilling exp 1.7, Shale density 2.63. Cuttings gas 3 units, Bakcground gas 45 units, Shale 80%, Marl 20%, Surveys: 8255'-5½°N 48°W Mud wt. 9.9, viscosity 45
Aug 19	8484'	Footage 202' Drilling 12¼" hole. Flowline temperature 55°C Drilling exp

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DAILY OPERATIONS REPORT

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WELL : COLUMBIA ET AL KOTANEELEE YT H38

DATE	DEPTH	DETAIL OF OPERATION
1977		
		1.77, Shale Density 2.62, Cuttings Gas 5 units, Background gas 35 units,
		Shale 20%, Limestone 80%, Weather - broken cloud, smoky
		Surveys:- 8325'-5°N 50°W. Mud wt. 9.8, viscosity 44
Aug 20	8631'	Footage 147'. Running in with Bit #43. Flowline temp. 62C,
		Drilling Exponent 1.78, Shale Density 2.62, Cuttings Gas 5 units,
		Background Gas 35 units, Shale 20%, Limestone 80%, Weather - overcast
		Surveys:-8475'-4 3/4°N 50°W. 8620'-4° . Mud wt. 9.8, viscosity 45
Aug 21	8810'	Footage 179' Drilling 12 1/4" hole. Flowline temp. 57C.
		Drilling exponent 1.70. Shale Density 2.63, Cuttings gas 10 units,
		Background gas 72 units. Shale 100%. Weather: Raining and broken
		cloud. Surveys:-8750'-4 1/4°N 36°W. Mud wt. 9.8, visc. 45
Aug 22	9030'	Footage 220'. Drilling 12 1/4" hole. Flowline temperature 60°C.
		Drilling Exponent 1.72, Shale Density 2.65, Cuttings Gas 8-12 units.
		Background Gas 90 units. Shale 100%. Weather - warm & clear.
		Surveys:-8910'-3 3/4°N 31°W. Mud wt. 9.8, visc. 44
Aug 23	9200'	Footage 170'. Tripping for bit. Flowline temperature 50°C. Drilling
		Exponent 1.68, Shale Density 2.65, Cuttings Gas 8-12 units. Background
		gas 180 units. Shale 100%. Surveys:-9100'-3 3/4°N 41°W. Mud wt. 9.9
		visc. 46
Aug 24	9240'	Footage 40'. Drilling 12 1/4" hole. Flowline temperature 58.1C,
		Drilling Exponent 1.98, Shale Density 2.65, Cuttings Gas 5 units.
		Background Gas 60 units. Shale 100%. Surveys:-9230'-3 3/4°N 43°W
		Mud wt. 10.0, viscosity 47
Aug 25	9310'	Footage 70'. Drilling 12 1/4" hole. Bit torquing, will pull at 8:30
		am. Flowline temp. 58.6°C. Drilling Exponent 2.0, Shale Density
		2.69, Total gas 7 units. Background gas 35 units. Shale 100%.
		Trace limestne. Surveys:-9290'-3 1/2°N 43°W. Mud wt. 9.9, visc 47
Aug 26	9415'	Footage 105'. Drilling 12 1/4" hole. Flowline temperature 60.7°C
		Drilling exponent 1.75, Shale Density 2.69, Total Gas 5 units.
		Background Gas 70 Units, Shale 100%. Weather - clear.
		Layed down ShockSub. Mud wt. 10.0, viscosity 48
Aug 27	9583'	Footage 168'. Drilling 12 1/4" hole. Flowline temperature 58.8°C

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DAILY OPERATIONS REPORT

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WELL COLUMBIA ET AL KOTANEELEE YT H38

DATE	DEPTH	DETAIL OF OPERATION
Aug 4	7295'	Footage 120' Drilling 12¼" hole 40 units background gas, Shale 80%, Lime
		stone 20% Weather clear and sunny. Surveys:-7225' 8°N 29°W Mud wt 9.5
		Viscosity 42
Aug 5	7367'	Footage 72' Drilling 12¼" hole 60 units background gas FLow line temp 125F
		weather-overcast Limestone 50%, Shale 50% Surveys 7290'-8¼°N 28W Mud wt 9.4
		viscosity 42
Aug 6	7484'	Footage 117' drilling 12¼"hole background gas 45 units Flowline temp 123F
		Total gas 10 units, drilling exponent 1.7 bulk density 2.65, Shale 40%,
		Limestone 60%, Surveys 7115'-8 3/4°N 28W Mud wt 9.5, viscosity 39
Aug 7	7605'	Footage 121' drilling 12¼" hole background gas 20 units, Flowline temp 125F
		Drilling Exponent 1.7, Bulk Density 2.56, Total gas 8 units, limestone 50%
		Shale 50% weather - raining
Aug 8	7707'	Footage 102' run in with Bit #38. Background gas 30 units, drilling exp 1.8
		Flowline temp 54.2°C, Bulk Density 2.66, Lime 75%, Shale 25%, total gas
		6 units, surveys:-7700' 7 1/4°N, 32W 7600'-7 1/2°N 32W mud wt 9.3 visc 41
Aug 9	7852'	Footage 145' Trip to check wash out. Background gas increased to 1000 units
		7740'-7770'. Dropped to 540 units 7770'-7800'. 1000 units 7800'-7820'
		130 units 7820'-7850' drilling exponent 1.60. Limestone 75% Shale 5%
		Chert 20% weather clear, Surveys:-7790' 7¼°N 32°W, mud wt. 9.5, visc 45
Aug 10	7888'	Footage 36' Drilling 12¼" hole. Flowline temp 54°C, Background Gas 100
		units, Bulk Density 2.62, Total Gas 7 units, Drilling Exponent 1.70,
		Will DST gas kick in Lower Flett this PM and core top of carbonate
		Limestone 70%, Shale 20%, Chert 10%, Surveys:7870'-6½°N 32°W, Mud wt. 9.7
		viscosity 47
Aug 11	7920'	Footage 22'. Run DST #1 7725'-7920' Preflow 10 min, strong airblow. GTS
		in 6 mins, now in initial shut in. Flowline temp 54.2°C, background gas
		100 units, total gas 8 units, drilling exponent 1.59, bulk density 2.58
		Shale 70%, Limestone 20% Marl 10%, mud wt. 9.8, viscosity 40
Aug 12	7920'	Footage nol. Run in with 12 1/4" bit. DST #1 7725'-7920'. Basal Flett
		10-30-60-120. Gas in place. Strong air blow, GTS in 6 minutes, after 10
		minutes 1.34 MMcf/d, after 20 min 1.30MMcf, after 30 1.32 MM, made slug
		of mud, 40-60 min, 820 Mcf/d. Received 900' of drilling mud. IHP 4032,
		~~IFP 1569, ISIP 3359, FP 746-674, FSIP 2894, FHP 3932~~

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DAILY OPERATIONS REPORT

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WELL : COLUMBIA ET AL KOTANEELEE YT H38

DATE	DEPTH	DETAIL OF OPERATION
1977		
		Drilling Exponent 1.72, Shale Density 2.70, Total Gas 2 units,
		Background Gas 60 Units. Shale 100%. Surveys:-9490'-2 3/4°N 48°W
		Mud wt. 9.8, viscosity 42
Aug 28	9650'	Footage 67'. Drilling 12 1/4" hole. Flowline temperature 58°C.
		Drilling Exponent 1.8, Shale Density 2.69. Total Gas 2 units.
		Background gas 60 units. Shale 100%. Weather - High scattered
		clouds. Surveys:-9610'-5°. Mud wt. 9.7, viscosity 45
Aug 29	9755'	Footage 105'. Drilling 12 1/4" hole. Flowline temperature 60.6°C
		Drilling Exponent 2.0, Shale Density 2.68, Total Gas 2.0 units. Back
		ground Gas 38 units. Shale 100%. Weather:-cloudy and wet. Surveys:-
		9740'-4 1/2°N 85°W. Mud wt. 9.7, viscosity 42
Aug 30	9813'	Footage 58'. Tripping for bit. Flowline temperature 62.4°C.
		Drilling Exponent 2.1 Shale Density 2.7, Total Gas 2 units, Background
		Gas 42 units. Shale 100%. Mud wt. 9.7, viscosity 45
Aug 31	9979'	Footage 156'. Drilling 12 1/4" hole. Flowline temperature 62.6°C
		Drilling Exponent 1.7, Shale Density 2.61, Cuttings Gas 13 units,
		Background Gas 100 Units. Shale 100%. Weather - clear
		Surveys:- 9950'-4 1/4°N 40°W. Mud wt. 9.6, visc. 43
Sept 1	10112'	Footage 133' Drilling 12 1/4" hole. Flowline Temperature 61°C.
		Drilling Exponent 1.84, Shale Density 2.68, Cuttings Gas 2 units,
		Background Gas 35 units. Shale 90%, Marl 10%. Weather - clear
		Mud wt. 9.7 viscosity 48
Sept 2	10202'	Footage 90'. Drilling 12 1/4" hole. Flowline temperature 60.8°C.
		Drilling Exponent 1.67, Shale Density 2.68, Cuttings Gas 8.0 units,
		Background Gas 80 units. Shale 90%, Marl 5%, Limestone 5%. Weather-
		cloudy and cool. surveys:- 10120'-5°. Mud wt. 9.7, viscosity 50
Sept 3	10328'	Drilling 12 1/4" hole. Flowline temperature 64.2°C. Background Gas
		70 units. Drilling Exponent 1.80, Shale Density 2.66, Cuttings Gas
		6.0 units. Shale 100%. Mud wt. 9.9, viscosity 42
Sept 4	10403'	Footage 75'. Tripping. Flowline temperature 62.4°C. Drilling
		Exponent 1.72, Shale Density 2.64, Background Gas 600-200 units.
		~~Shale 95%. Limestone 5%.~~ * ~~Mud wt. 9.7, visc. 41~~ Surveys:- 10403- 4 3/4°
		Totco,

D&S PETROLEUM CONSULTANTS LTD.

DAILY OPERATIONS REPORT

73F8

WELL: COLUMBIA ET AL KOTANEELEE YT H38

DATE	DEPTH	DETAIL OF OPERATION
1977		
Sept 5	10,621'	Footage 218'. Drilling 12 1/4" hole. Flowline temperature 62.1°C Background Gas 325 units. Drilling exponent 1.81, Cuttings Gas 20 units. Chert 90%, Shale 10%. Weather - overcast and raining. Mud wt. 9.7, visc. 44
Sept 6	10,677'	Footage 56'. Tripping. Flowline temperature 63°C. Drilling exponent 1.96, Shale Density 2.72, Background Gas 260 units, Cuttings Gas 20 units. Shale 70%, Chert 10%, Marl 20%. Weather - overcast. Surveys:-10,677' - 49°N, 4 1/2°W. Mud wt. 9.8, visc. 42
Sept 7	10,795'	Footage 118'. Drilling 12 1/4" hole. Flowline temperature 63,8°C Drilling Exponent 1.82, Shale Density 2.68, Background Gas 300 units. Cuttings Gas 3.0 units, Shale 100% Mud wt. 9.8, visc 45
Sept 8	10,850'	Footage 55'. Logging - Schlumberger. Logging depth 10,805' Flowline temperature 64°C, Drilling Exponent 1.9, Shale Density 2.67 Background Gas 300 units, Cuttings Gas 3 units. Surveys:- 10840' - 4 1/2°. Mud wt. 9.7, viscosity 40
Sept 9	10,850'	No footage. Completed DILL & Sonic GR caliper 10,805' - 3021'. Ran in hole with CNL-FDC; tool problem, repaired same. Ran back with CNL-FDC to 4000'. Driller working on draworks brake, dropped blocks and damaged Schlumberger's sheave, wt. indicator, and cable. Restrung travelling blocks, pulled Schlumberger tool out of hole and cut off 3100' logging line. Picking up new sheave at Beaver River. Should be logging at 10:00 AM today.
Sept 10	10,850'	No footage. Waiting on additional logging tools. Strung 10 lines while waiting for Otter to return from Dawson Creek with second CNL-FDC tool. Ran in to log CNL-FDC, tool would not work. Leaving for Dawson Dreek to pick up third CNL-FDC tool at daybreak.
Sept 11	10,850'	No footage. Ran CNL-FDC log 10,805 - 8021'. Finished logging, rigged out loggers. Ran inhole with bit to circulate hole. Clean approx. 60' of fill.
Sept 12	10,850'	No footage. Tripping and circulating, conditioning hole to run casing. Pulled out of hole, laying down 9" & 7 1/2" drill collars and BH assembly. Mud wt. 9.7, viscosity 46

D&S PETROLEUM CONSULTANTS LTD.

DAILY OPERATIONS REPORT

73F8

WELL : COLUMBIA ET AL KOTANEELEE YT H38

DATE	DEPTH	DETAIL OF OPERATION
1977		
Sept 13	10,850'	No footage. Running 9 5/8" casing. Break and lay down Bottom Hole assembly, change pipe rams, rig to and run 9 5/8" casing, 62 joints in. Weather - raining.
Sept 14	10,850'	No footage. Running 9 5/8" casing. 237 joints in, 29 joints left to run. Weather - clearing.
Sept 15	10,850'	No footage. Wait on Cement. Ran 266 joints (10,862') 9 5/8", mod N80 43.5# buttress and 47# N80 8 rd with stage collar at 8880'. Cemented casing at 10,827' with 600 sacks Class "G" cement, retarded on bottom and 1400 sacks on second stage. Plugs down at 12:00 midnight and 5:00 AM Sept 15. Carried out as per casing program. Weather - broken
Sept 16	10,850'	No footage. Nipple up BOP's and preparing to pressure test. Change pump liners to 5 1/2", rams from 95/8" to 5", pick up BOP's, set slips cut off casing, pick up 9 - 6 1/4" collars. Weather - clear
Sept 17	10,850'	No footage. Drilling out DV tool. Installed 7" casing hangar. Tested seals, pressured up seal assembly to 3000 psi, held OK. Nippled up BOP's, flareline, accumulator line and turnbuckles on BOP's. Pressure tested blind rams, kill line and manifold to 4500 psi, held OK. Installed wear bushing and ran in hole to drill out DV tool.
Sept 18	10,920'	70' Tripping for bit. Drilled out DV tool, tagged float collar. Pressure tested hydril to 2000 psi, upper and lower pipe rams to 4500, casing to 4500. Drilled out float collar and float shoe, and 15' of new hole. Pressure tested formation to 700 psi. Shoe at 10,850' KB. Prepared remote control Cameron choke. Flowline temp 55.2°C, Back ground Gas 80 units, Cuttings Gas 18 units, Drilling Exponent 4.9, Shale Density 2.65, Shale 80%, Chert 20%, clay trace. Mud wt. 9.4 viscosity 36
Sept 19	10,982'	62' Drilling 8 1/2" hole. Flowline temp 58.4C. Background Gas 150 units, Cuttings Gas 14 units, Shale Density 2.67, Drilling Exponent 2.06 Trip Gas 1000 units, Shale 80%, Chert 20%. Weather - clear. Surveys:- 10,920' - 3 7/8°. Mud wt. 9.6, viscosity 40
Sept 20	11,045'	63' Drilling 8 1/2" hole. Gov't BOP check OK. Flowline temp 56.6C Background Gas 195 units, Cuttings Gas 7 units, Shale Density 2.7,

D&S PETROLEUM CONSULTANTS LTD.

DAILY OPERATIONS REPORT

73F 8

WELL : COLUMBIA ET AL KOTANEELEE YT H38

DATE	DEPTH	DETAIL OF OPERATION
1977		
		Drilling Exponent 2.08. Trip Gas 1000 units. Shale 90%, Limestone 10%
		Weather - high scattered. Surveys:- 11,025' - 5°. Mud wt 9.5, visc. 40
Sept 21	11,158'	113' Drilling 8 1/2" hole. Flowline temp 60.4C, Background Gas 200
		units, Cuttings Gas 3 units, Shale Density 2.7, Drilling Exponent
		1.93. Shale 90%, Siltstone 10%. Weather - clear and mild
		Mud wt. 9.9, viscosity 35
Sept 22	11,240'	82' Drilling 8 1/2" hole. Flowline temperature 62C, Drilling
		Exponent 1.92, Shale Density 2.69, Background Gas 360 units, Cuttings
		Gas 4.0 units. Shale 90%, Limestone 5%, Dolomite 5%. Mud wt 9.9,
		Viscosity 36
Sept 23	11,300'	60' Drilling 8 1/2" hole, Flowline temp 57C, Background Gas 320 units
		Cuttings Gas 3 units, Shale Density 2.62, Drilling Exponent 1.72,
		Shale 95%, Carbonate 5%. Surveys 11,254'-6°, Mud wt 9.9, visc 36
Sept 24	11,387'	87' Drilling 8 1/2" hole. Flowline temp 62C, Background Gas 280 units,
		Cuttings Gas 10 units, Shale Density 2.65, Drilling Exponent 1.82,
		Shale 90%, Carbonate 10%. Weather - cloudy. Surveys:- 11,362'-6 1/2°
		Mud wt. 9.9, viscosity 36
Sept 25	11,447'	60'. Drilling 8 1/2" hole. Flowline temperature 59C, Background Gas
		180 units, Cuttings Gas 8 units, Shale Density 2.6, Drilling Exponent
		1.75, Shale 100%. Weather - high. Surveys:-11,362'-6 1/2°.
		Mud wt. 9.9, viscosity 36
Sept 26	11,527'	80' Drilling 8 1/2" hole. Flowline temp 61C. Background Gas 400 units,
		Cuttings Gas 10 units, Shale Density 2.66, Drilling Exponent 1.88,
		Shale 100%, Weather - clear. Surveys:- 11,422'-6 3/4°. Mud wt 9.9,
		Viscosity 37
Sept 27	11,654'	127' PUll to run core barrel. Will cut 60' of core. Carbonate 11,640
		Flowline temp 141F, Background Gas 400-900 units, Drilling Exponent
		1.71, Shale Density 2.65, Cuttings Gas 6 units. 95% Limestone,
		5% Chert. Mud wt. 9.8, visc 37
Sept 28	11,690'	36' Pick up test tools. DST #2 11,630' - 11,690'. Flowline temp
		57.3C, Background Gas 450 units, Cuttings Gas 6 units, Drilling
		Exponent 1.31, 100% Dolomite. Surveys:- 11,654'-6 1/4°

D&S PETROLEUM CONSULTANTS LTD.

DAILY OPERATIONS REPORT

73F 8

WELL COLUMBIA ET AL KOTANEELEE YT H38

DATE	DEPTH	DETAIL OF OPERATION
1977		
Sept29	11,690'	No footage. DST #2. Tripping out, will run core barrel. DST #2, 11,630'-11,690' 3500' water cushion. 10-60-120-240. Weak air blow. Water cushion and gas to surface in 30 minutes; from 4.064 MMCF/d in 60 minutes to 1.832 MMCF/d in 120 minutes. Recovered 750' gassy water cushion. HP 5976, PF 1619, ISIP - 5608, FP-1748-659, FSIP 5680 FHP 5976 Mud wt. 9.9, visc 37
Sept 30	11,732'	42' Cutting core #2, 11,690'-11,732'. Will continue to 11,750'. Corrected Flow Rates on DST #2 - 5.09 MMcf/d, decreasing at end of test to 2.30 MMcf/d. Flowline temp 59C, Backqround Gas 230 units, Drilling Exponent 1.65, cuttings Gas 5 - 6 units. Dolomite 100% Mud wt. 10.0, visc 42
Oct 1	11,787'	55' Core #2 11,690' - 11,750'. Recovered 60'. Flowline temp 61.2C, Background Gas 280 units, Drilling Exponent 1.53, Cuttings Gas 6 units, 100% Dolomite Mud wt. 9.9, viscosity 37
Oct 2	11,890'	103' Running DST #3 11,680'-11,890' (210') 2500' water cushion. Flowline temperature 58.9C, Gackground Gas 215 units, Drilling Ex. 1.43 Cuttings Gas 12 units, Dolomite 100%. Mud wt. 10.0, Visc 37
Oct 3	11,890'	No footage. Running DST #4 - DST #3 - 11,680'-11,890' misrun. Strong air blow on preflow. Gas to surface on initial shut-in. Lost seat on valve opening. ISIP 5624. Had 2500' of water cushion. Circulated out gas kick thru pump out sub. Running DST #4 11,695'-11,890', 3500' water cushion. Misrun, lost seat on preflow, start out of hole.
Oct 4	11,890'	No footage. Running in with DST #5 - 11,620'-11,890'. 3 packers and 3500' water cushiom. Bled off gas from DST #4, jarred packer loose, pulled out, no damage to rubbers, added extra rubber, changed interval and changed hydraulic tool, rerun test.
Oct 5	11,895'	5' Drilling 8 1/2" hole. Ran DST #5, 11,620'-11,890'. 10-60-120-240 Fair air blow. Gas to surface in 45 minutes of initial shut in. Water cushion in 10 minutes of valve open. Recovered 800' of muddy water cushion. Gas at 50 min - 10 MMcf/d - wet gas, at 60 min, 9.4 MMcf/d wet gas, 70 min - 8.6 MMcf/d, wet gas - 80 min, 7.6 MMcf/d drying up IHP 5886, ISIP 5608, FP 1831-906. FSIP -5608, FHP-5850, BHT 286F

D&S PETROLEUM CONSULTANTS LTD.

DAILY OPERATIONS REPORT

73F8

WELL : COLUMBIA ET AL KOTANEELEE YT H38

DATE	DEPTH	DETAIL OF OPERATION
1977		
Oct 6	12,040'	145' Running in to cut core #3. Circulated out gas kick from DST #5.
		Background Gas 235 - 520 units. Weather - broken cloud had skiff
		of snow. Mud wt 9.8, viscosity 37
Oct 7	12,094'	54' Drilling 8 1/2" hole. Cut and recovered core #3. 12,040'-12,064'
		Recovered 24'. Core jammed. Ran 8 1/2" bit, drilling ahead. Back
		ground Gas 340 units, Drilling Exponent 1.67, Cuttings Gas 7 units,
		Flowline temp 46.2C, Dolomite 100%. Weather - fogged in. Mud wt 10.0
		viscosity 38
Oct 8	12,285'	191' Cutting core #4, 12,260'-12,285'. Will core to 12,320'.
		Flowline temp 49.6C, Background Gas 250 units, Cuttings Gas 4 units,
		Drilling Exponent 1.39, Dolomite 100%. Mud wt 10.0, visc 36
Oct 9	12,450'	165' Drilling 8 1/2" hole. Will core at 12,450'. Core #4 recovered
		60'. Background Gas 370 units, Drilling Exponent 1.49, cuttings Gas
		3 units, Flowline temp 56.3C, Dolomite 100%. Mud wt 9.9, visc 36
Oct 10	12,510'	60' Cut core #5, 12,450'-12,510'. Pulling core barrel. Background
		Gas 75 units, Drilling Exponent 1.56, Cuttings Gas 4 units, Flowline
		temp 60.5C, Dolomite 100% Mud wt. 10.0, Visc 42
Oct 11	12,675'	165' Drilling 8 1/2" hole. Background Gas 140 - 600 units, Drilling
		Exponent 1.75, Cuttings Gas 3 units, Flowline temp 65.6C, Dolomite 100%
		Mud wt. 10.0. visc 42
Oct 12	12,713'	38' Cutting core #6. 12,708-12,713'. Will core to 12,768'.
		Background Gas 360 units, Drilling Exponent 1.88, Cuttings Gas 2 units
		Flowline temp 66.7C. Dolomite 100%. Mud wt. 10.1, visc 42
Oct 13	12,758'	50' On bottom. Cutting core #7, from 12,755'. Core #6 12,708'-
		12,755'. (47') Recovered 47'. Background Gas 500 units, Trip Gas 2000
		units, Cuttings Gas 2 units, Flowline Temp 57.5°C. Dolomite 100%
		Mud wt. 10.1, visc 37
Oct 14	12,789'	31' Logging - CNL-FDC log. Core #7, 12,755'-12,789', recovered 34'
		Background Gas 400 - 480 units. Cuttings Gas 3 units. Dolomite 100%
		Mud wt. 10.0, visc 46
Oct 15	12,789'	TD Logging. CNL-FDC-GR. 12,789'-10,850' GR failed after 400'.

D&S PETROLEUM CONSULTANTS LTD.

DAILY OPERATIONS REPORT

73F 8

WELL : COLUMBIA ET AL KOTANEELEE YT H38

DATE	DEPTH	DETAIL OF OPERATION
1977		
		Dipmeter 12,789'-12,850'. Dual LLGR 12,789'-10,850'. BHC-SGC
		10,789'-10,850'. Now running Variable Density
Oct 16	12,789'	Circulate and condition mud. Variable Density and Wavetrain 12,789'-
		11,500'. Velocity 10,200' to surface. Tool would not go any deeper
		Had gas kick when bottom circulated up. Mud wt. 9.9, visc 44
Oct 17	12,789'	Laying down drill collars. Layed down 389 joints of drill pipe.
		circulated and conditioned mud prior to laying down drill pipe.
		Weather - high overcast, very windy, unable to fly.
		Mud wt. 10.0, visc 43
Oct 18	12,789'	Running 7" casing - 150 joints run
Oct 19	12,789'	WOC. Ran 225 joints (8899') 7" 32# Mod N80 LT&C, 98 joints (3899')
		7" 29# mod N80 buttress, set @ 12,789'. Cemented by 500 sacks
		oilwell class "G", 30% silica flour, 1% R-55, .5% T10. Plug down at
		3:50 AM Oct 19. Bumped plug with 500 PSI+. Held OK. Good mud returns
		throughout. Weather - windy - unable to fly.
Oct 20	12,789	WOC. Waiting on completion program
Oct 21	12,789	Waiting on completion equipment. Set 7" casing slips, made first
		cut on 7" casing. Set slips at 320,000 lbs. tension
Oct 22	12,789	Waiting on completion equipment. RIG RELEASED from drilling
		operations 12:00 noon, October 21
Oct 23	12,789	Waiting on completion equipment
Oct 24	12,789	Waiting on completion equipment. Tagged cement top at 12,681. Ran
		Gamma-Ray Neutron Correlation log 12,681'-11,500'.
		Weather - clearing, wet and windy, airstrip wet
Oct 25	12,789	PBD 12,681'. Waiting on completion equipment. Installed 4 1/2"
		tubing hangar. DC-3 unable to fly yesterday, will bring in BH
		assembly today.
Oct 26	12,789	PBD 12,681. Running 4 1/2" CS Hydril tubing. Moved in tubing equip-
		ment and running tools. Ran 7" Baker Model "D" production packer on
		Schlumberger line and set at 11,540'. Made up and ran Bottom Hole
		assembly as per program. Rigged up tongs and Gater Hawk tube test
		equipment and shut down for night.

D&S PETROLEUM CONSULTANTS LTD.

DAILY OPERATIONS REPORT

73F8

WELL : COLUMBIA ET AL KOTANEELEE YT H38

DATE	DEPTH	DETAIL OF OPERATION
1977		
Oct 27	12,789'	PBD 12,681'. Running 4 1/2" CS Hydril tubing. Ran 132 joints.
		Pressure testing connecitons to 8000 psi. Weather - clear & mild
OCt 28	12,789'	PBD 12,681'. Running 4 1/2" CS Hydril tubing. 330 joints run,
		45 left to run.
Oct 29	12,789'	PBD 12,681'. Flowing well to pit. Ran 4 1/2" CS Hydril tubing to
		sting into Baker Model "D" packer at 11,540', latched into packer, and
		sheared pins in tubing seal receptacle, took right torque and pulled
		up out of "J" slot in receptacle. Spacedout final hook-up. Circulated
		hole with 375 Bbls of inhibited water using 1% Coroban. Displaced
		2 Bbls of diesel fuel down annulus. Installed wellhead and landed
		tubing in packer with tubing seal receptacle open 5'.
		Mule shoe landed at 11,606'. Baker model "D" landed at 11,540'.
		Top of bottom hole assembly 11,420'. Used a total of 375 joints
		of 4 1/2" CS Hydril C-75, 12.75# tubing. Pressure tested with Nowsco
		on annulus to 5400 psi, on wellhead and tubing to 6400 psi. Held OK
		for 15 minutes on each test. Ran Schlumberger 2 1/8" scallop guns
		and perforated from 11,641' to 11,900' as per program, with 2 shots
		per foot (148') 308 shots. Water started to flow after last gun.
		Hooked up to flare line and blew water and gas till flare decreased to
		approximately 1 million.
		RIG RELEASED 8:00 AM, October 29, 1977
		the following intervals have been perforated
		11,641' - 11,665' 24' 11,803' - 11,806' 3'
		11,668' - 11,687' 19' 11,809' - 11,818' 9'
		11,700' - 11,720' 20' 11,824' - 11,831' 7'
		11,729' - 11,742' 13' 11,847' - 11,854' 7'
		11,763' - 11,780' 17' 11,857' - 11,867' 10'
		11,789' - 11,792' 3' 11,871' - 11,874' 3'
		11,795' - 11,798' 3' 11,890' - 11,900' 10'
		TOTAL 148 feet, 310 shots
Oct 30	12,789'	PBD 12,681' Flowing well to pit. Tearing out rig. Flowing on 3/8"
		choke with 400 psi back pressure

D&S PETROLEUM CONSULTANTS LTD.

DAILY OPERATIONS REPORT

73F 8

WELL: COLUMBIA ET AL KOTANEELEE YT H38

DATE	DEPTH	DETAIL OF OPERATION
1977		
Oct 31	12,789'	PBD 12,681' Flowing well to pit, tearing out rig. Shut well in for 4 hours, SIP 4200 psig. Blew well down for one hour full open, slight spray of water and mud, continued to flow through 3/8" choke 350 psig back pressure. Will shut well in to tear out rig. FINAL REPORT

SECTION IV

Logs

	Run #1	Run #2	Run #3
CNL-FDC-GR	772-3020' ✓	3020-10804' ✓	10838-12780' ✓
DILL	772-3021' ✓	3020-10800' ✓	
BHCS	772-3018' ✓	3020-10756' ✓	10840-12778' ✓
Dual Laterlog			10840-12770' ✓
Sonic Wavetrain			11450-12775' ✓
Open Hole Variable Density			11500-12776' ✓
Dipmeter			10840-12789' ✓

NOTE: All logs distributed as received

264-9380

SECTION IV

I LOGS

TYPE OF LOG	INTERVAL	DATE RUN	# of Copies
Dual Induction-Laterolog	772-3015	May 23, 1977 ✓	2
Compensated Neutron-Formation Density	772-3020	May 23, 1977 ✓	2
Borehole Compensated Sonic Log	772-3018	May 23, 1977 ✓	2
Dual Induction-Laterolog	3020-10800	Sept. 8, 1977 ✓	3
Compensated Neutron-Formation Density	3020-10804	Sept. 10, 1977 ✓	3
Borehole Compensated Sonic Log	3020-10758	Sept. 8, 1977 ✓	3
Dual Laterolog	10840-12770	Oct. 15, 1977 ✓	3
Compensated Neutron-Formation Density	10838-12780	Oct. 14, 1977 ✓	3
Open Hole Variable Density Log	11500-12776	Oct. 15, 1977 ✓	3
Borehole Compensated Sonic Log	10840-12778	Oct. 15, 1977 ✓	3
Sonic Wave Form Photographs	11450-12775	Oct. 15, 1977 ✓	3
Exploration Logging Lithology Log	1000-12789	April 25 - Oct. 14, 1977 ✓	2
Exploration Logging Formation Pressure Log	1000-12789	April 25 - Oct. 14, 1977 ✓	2
ompletion Record	11350 - 11920	29 Oct. 77 ✓	3
logram Survey		15 Oct 77 ✓	3
Continuous Dipmeter (computed)	10840 - 12779	14 Oct 77 ✓	3
" "		14 Oct 77 ✓	3
Cortland		8 Sept 77 ✓	2
ompensated Neutron Log	11500 - 12677	23 Oct. 77	3

DST 1, 2, 3 4+5

Fluid Analyses

Final Report - 2 copies

SECTION V

Analyses

COLUMBIA ET AL KOTANEELEE

YT H-38

Core No. 1	8134 - 8169	35'
Core No. 2	11690 - 11750	60'
Core No. 3	12040 - 12-64	24'
Core No. 4	12260 - 12390	60'
Core No. 5	12450 - 12510	60'
Core No. 6	12708 - 12755	47'
Core No. 7	12755 - 12789	34'

Drill Stem Test No. 1	7725 - 7920	195'
Drill Stem Test No. 2	11630 - 11690	30'
Drill Stem Test No. 3	11680 - 11890	misrun
Drill Stem Test No. 4	11695 - 11890	misrun
Drill Stem Test No. 5	11620 - 11890	270'

	Run No. 1	Run No. 2	Run No. 3
CNL-FDC-GR	772 - 3020	3020 - 10804	10838 - 12780
DILL	772 - 3021	3020 - 10800	
BHCS	772 - 3018	3020 - 10756	10840 - 12788
Dual Laterlog			10840 - 12770
Sonic Wave Train			11450 - 12775
Open Hole Variable Density			11500 - 12776
Dipmeter			10840 - 12780

CORE LABORATORIES - CANADA, LTD.

Company	COLUMBIA GAS DEVELOPMENT OF CANADA LTD.	Formation	NAHANNI	Page	1 of 11
Well	COLUMBIA ET AL KOTANEELEE YT H-38	Drilling Fluid	WATER BASE MUD	File	7004-7571
Field	KOTANEELEE, NORTHWEST TERRITORIES	Elevation		Date Report	NOVEMBER 21, 1977
Location	60° 07' 16" N.L. 124° 06' 03" W.L.	Analysis	FULL DIAMETER	Analysts	BK JL JC TC MW CP
		Remarks			

AST - APPEARS SIMILAR TO; * - BROKEN CORE (K90 USED FOR SUMMARY PURPOSES); ** - PERMEABILITY > 30000 MD
FS - FINE SAND; MS - MEDIUM SAND; CS - COARSE SAND
CONG - CONGLOMERATE; DOL - DOLOMITE; SH - SHALE; LMY - LIMY
SHY - SHALY; BK - BREAK; BIT - PYROBITUMEN; CARB - CARBONACEOUS
A - ANHYDRITE; FOSS - FOSSILIFEROUS; XLN - CRYSTALLINE; LAM - LAMINATIONS
V - VUGULAR; LV - LARGE VUGS; SV - SMALL VUGS; PPV - PINPOINT VUGS
I - INTERGRANULAR; STY - STYLOLITIC; HF - HORIZONTAL FRACTURE; VF - VERTICAL FRACTURE
SS - SMALL PLUG SAMPLE; SLY - SLIGHTLY; V - VERY; W - WITH

Sample Number	Interval Represented, Feet		Permeability to Air, Millidarcys			Permeability Feet	Porosity, Per Cent	Porosity Feet	Density; gm./cc.		Residual Saturations, Per Cent Pore Space		Visual Examination
	Depth	Thick	K Max	K90°	KV				Bulk	Grain	Oil	Total Water	
	CORED INTERVAL 11690.0' - 12789.0'												
	CORE NO. 2 11690.0' - 11750.0' (REC. 59.0') (16 BOXES)												
1	11690.0-91.0	1.0	0.37	0.30	-0.01	0.37	1.7	1.70	2.77	2.82			SV PPV F
2	11691.0-92.2	1.2	1.21	0.53	-0.01	1.45	1.9	2.28	2.77	2.82			SV PPV F
3	11692.2-93.5	1.3	0.69	0.08	-0.01	0.90	1.0	1.30	2.79	2.82			PPV F
4	11693.5-94.4	0.9	0.06	0.03	-0.01	0.05	0.8	0.72	2.79	2.82			SV
5	11694.4-95.4	1.0	0.21	-0.01	-0.01	0.21	1.0	1.00	2.78	2.81			SV F
6	11695.4-96.3	0.9	1.13	0.36	-0.01	1.02	1.4	1.26	2.77	2.81			SV F
7	11696.3-97.6	1.3	0.59	0.21	0.10	0.76	1.3	1.69	2.79	2.83			SV F
8	11697.6-98.7	1.1	557.00	11.60	0.31	612.70	8.1	8.91	2.59	2.82			LV SV F
9	11698.7-99.9	1.2	1.24	1.10	-0.01	1.49	2.5	3.00	2.74	2.81			SV F
10	11699.9-01.2	1.3	0.57	0.38	-0.01	0.74	1.6	2.08	2.76	2.81			SV F
11	11701.2-02.3	1.1	0.53	0.41	-0.01	0.58	2.7	2.97	2.73	2.81			SV F
12	11702.3-03.4	1.1	1.54	0.98	-0.01	1.69	2.4	2.64	2.76	2.83			SV F
13	11703.4-04.4	1.0	1.82	1.46	-0.01	1.82	2.6	2.60	2.75	2.83			SV F
14	11704.4-05.1	0.7	0.80	0.58	-0.01	0.56	0.8	0.56	2.81	2.83			DENSE F
15	11705.1-06.0	0.9	5.72	0.58	-0.01	5.15	1.4	1.26	2.79	2.83			SV F
16	11706.0-07.0	1.0	1.08	0.78	-0.01	1.08	5.3	5.30	2.69	2.84			SV F
17	11707.0-07.7	0.7	10.40	1.91	-0.01	7.28	2.2	1.54	2.75	2.81			SV F
18	11707.7-08.5	0.8	0.27	0.24	-0.01	0.21	2.7	2.16	2.75	2.82			SV F
19	11708.5-09.5	1.0	19.80	3.98	-0.01	19.80	2.1	2.10	2.76	2.83			SV F
20	11709.5-10.7	1.2	16.40	0.08	-0.01	19.68	1.9	2.28	2.76	2.81			SV F
21	11710.7-11.7	1.0	8.94	1.89	0.06	8.94	2.6	2.60	2.76	2.83			SV F
22	11711.7-12.7	1.0	27.30	5.60	0.11	27.30	4.1	4.10	2.71	2.83			SV F
23	11712.7-13.6	0.9	2.55	2.33	0.07	2.30	3.0	2.70	2.76	2.85			SV F
24	11713.6-14.7	1.1	1.33	0.52	-0.01	1.46	2.0	2.20	2.77	2.83			SV PPV F
25	11714.7-15.7	1.0	1.30	1.11	-0.01	1.30	1.8	1.80	2.77	2.82			SV F
26	11715.7-16.2	0.5	9.02	0.71	0.07	4.51	3.7	1.85	2.73	2.84			SV PPV F

Company COLUMBIA GAS DEVELOPMENT OF CANADA LTD. Formation NAHANNI Page 2 of 11
Well COLUMBIA ET AL KOTANEELEE YT H-38 Drilling Fluid WATER BASE MUD File 7004-7571

Sample Number	Interval Represented, Feet		Permeability to Air, Millidarcys			Permeability Feet	Porosity, Per Cent	Porosity Feet	Density, gm./cc.		Residual Saturations, Per Cent Pore Space		Visual Examination
	Depth	Thick	K Max	K90°	KV				Bulk	Grain	Oil	Total Water	
			CORE NO. 2 CONTINUED										
27	11716.2-17.0	0.8	**	3.69	0.28	2.95	10.6	8.48	2.53	2.83			LV SV F
28	11717.0-18.1	1.1	1.15	1.05	-0.01	1.27	4.5	4.95	2.68	2.81			SV F
29	11718.1-19.1	1.0	10.90	4.61	-0.01	10.90	4.7	4.70	2.68	2.81			SV F
30	11719.1-20.3	1.2	7.09	1.53	0.17	8.51	3.3	3.96	2.73	2.82			SV PPV F
31	11720.3-21.3	1.0	1.71	0.06	0.35	1.71	7.3	7.30	2.62	2.83			LV SV F
32	11721.3-22.0	0.7	**	2.21	0.05	1.55	7.3	5.11	2.63	2.84			LV SV F
33	11722.0-22.9	0.9	0.33	-0.01	0.07	0.29	1.1	0.99	2.79	2.82			SV F
34	11722.9-23.8	0.9	7.94	3.64	0.11	7.15	2.7	2.43	2.74	2.82			SV F
35	11723.8-24.8	1.0	1.83	1.78	0.16	1.83	2.7	2.70	2.75	2.82			SV F
36	11724.8-25.7	0.9	0.57	0.30	0.09	0.51	2.4	2.16	2.75	2.82			SV F
37	11725.7-26.6	0.9	1.32	0.21	-0.01	1.19	1.8	1.62	2.76	2.81			SV F
38	11726.6-27.6	1.0	5.75	0.31	0.18	5.75	3.6	3.60	2.71	2.81			SV F
39	11727.6-28.5	0.9	1.09	0.14	0.11	0.98	6.5	5.85	2.62	2.80			SV F
40	11728.5-29.4	0.9	4.86	-0.01	0.14	4.37	4.3	3.87	2.70	2.83			SV F
41	11729.4-30.9	1.5	0.81	0.50	0.16	1.22	1.1	1.65	2.79	2.82			PPV F
42	11730.9-31.9	1.0	0.37	-0.01	-0.01	0.37	1.8	1.80	2.75	2.80			PPV F
43	11731.9-32.4	0.5	3.92	3.82	0.08	1.96	3.8	1.90	2.72	2.83			SV F
44	11732.4-33.3	0.9	2.83	1.08	0.07	2.55	3.9	3.51	2.73	2.84			SV F
45	11733.3-34.1	0.8	**	4.91	0.08	3.93	8.8	7.04	2.59	2.84			LV SV F
46	11734.1-35.1	1.0	0.28	0.20	-0.01	0.28	1.8	1.80	2.77	2.82			SV PPV F
47	11735.1-36.2	1.1	0.78	0.49	-0.01	0.86	1.5	1.65	2.80	2.84			SV PPV F
48	11736.2-37.4	1.2	1.47	0.66	0.13	1.76	2.8	3.36	2.74	2.83			SV F
49	11737.4-38.5	1.1	1.28	0.38	0.08	1.41	3.1	3.41	2.73	2.82			SV PPV F
50	11738.5-39.6	1.1	7.27	5.67	0.52	8.00	5.5	6.05	2.60	2.75			SV PPV F
51	11739.6-40.5	0.9	5.23	4.29	-0.01	4.71	2.5	2.25	2.75	2.82			SV F
52	11740.5-41.6	1.1	1.14	0.32	0.16	1.25	1.7	1.87	2.78	2.83			SV F
53	11741.6-42.7	1.1	0.13	-0.01	-0.01	0.14	1.4	1.54	2.79	2.83			SV PPV F
54	11742.7-43.6	0.9	22.80	15.70	0.95	20.52	3.1	2.79	2.76	2.85			SV PPV F
SS 55	11743.6-44.6	1.0	0.36	-	-	0.36	2.0	2.00	-	-			I RUBBLE
SS 56	11744.6-45.5	0.9	0.11	-	-	0.10	2.2	1.98	-	-			I RUBBLE
57	11745.5-47.2	1.7	0.38	-0.01	-0.01	0.65	1.4	2.38	2.77	2.81			PPV F
58	11747.2-49.0	1.8	1.21	0.73	-0.01	2.18	1.5	2.70	2.76	2.80			SV PPV F

Company COLUMBIA GAS DEVELOPMENT OF CANADA LTD.
Well COLUMBIA ET AL KOTANEELEE YT H-38
Formation NAHANNI
Drilling Fluid WATER BASE MUD

File 7004-7571

Sample Number	Interval Represented, Feet, Depth	Thick	Permeability to Air, Millidarcys K Max	$K_{90°}$	KV	Permeability Feet	Porosity, Per Cent	Porosity Feet	Density, gm./cc. Bulk	Grain	Residual Saturations, Per Cent Pore Space Oil	Total Water	Visual Examination
			CORE NO. 2 CONTINUED										
-	11749.0-50.0	1.0	-	-	-	-	-	-	-	-			LOST CORE
-	11750.0-40.0	290.0	-	-	-	-	-	-	-	-			DRILLED
			CORE NO. 3 12040.0' - 12064.0' (REC. 22.0') (6 BOXES)										
59	12040.0-40.9	0.9	0.49	0.31	0.08	0.44	2.7	2.43	2.78	2.86			SV PPV F
60	12040.9-41.9	1.0	**	0.59	0.16	0.59	4.7	4.70	2.74	2.88			LV SV F
61	12041.9-42.9	1.0	12.00	3.68	0.14	12.00	2.0	2.00	2.80	2.86			SV F
62	12042.9-43.8	0.9	0.63	0.61	0.14	0.57	1.2	1.08	2.82	2.86			SV F
63	12043.8-44.8	1.0	15.20	8.47	0.70	15.20	5.0	5.00	2.71	2.86			SV F
64	12044.8-45.7	0.9	28.00	0.22	2.14	25.20	4.6	4.14	2.72	2.86			SV VF
65	12045.7-46.7	1.0	253.00	4.67	1.10	253.00	3.9	3.90	2.74	2.85			SV VF
66	12046.7-48.1	1.4	0.22	-0.01	0.18	0.31	3.1	4.34	2.76	2.85			SV PPV F
67	12048.1-49.6	1.5	**	0.07	0.73	0.11	8.6	12.90	2.61	2.85			LV SV F
68	12049.6-50.6	1.0	4.83	0.44	0.38	4.83	6.3	6.30	2.67	2.85			SV F
69	12050.6-51.5	0.9	119.00	0.07	9.01	107.10	6.5	5.85	2.67	2.86			SV F
70	12051.5-52.6	1.1	2.95	0.49	-0.01	3.25	5.3	5.83	2.70	2.86			SV F
71	12052.6-53.2	0.6	0.92	0.58	0.15	0.55	1.5	0.90	2.81	2.85			SV F
72	12053.2-54.0	0.8	2.18	1.51	2.21	1.74	2.5	2.00	2.78	2.85			SV VF
73	12054.0-55.1	1.1	1.12	0.65	0.37	1.23	1.2	1.32	2.82	2.85			I F
74	12055.1-56.3	1.2	3.63	1.31	0.11	4.36	0.9	1.08	2.82	2.85			SV F
SS 75	12056.3-57.3	1.0	0.65	-	-	0.65	1.6	1.60	-	-			I RUBBLE
SS 76	12057.3-58.2	0.9	0.61	-	-	0.55	4.1	3.69	-	-			I RUBBLE
SS 57	12058.2-59.2	1.0	0.18	-	-	0.18	1.7	1.70	-	-			I RUBBLE
SS 78	12059.2-60.1	0.9	0.26	-	-	0.23	1.5	1.35	-	-			PPV RUBBLE
SS 79	12060.1-61.1	1.0	0.25	-	-	0.25	1.1	1.10	-	-			I RUBBLE
SS 80	12061.1-62.0	0.9	0.26	-	-	0.23	1.8	1.62	-	-			I RUBBLE
-	12062.0-64.0	2.0	-	-	-	-	-	-	-	-			LOST CORE
-	12064.0-60.0	196.0	-	-	-	-	-	-	-	-			DRILLED
			CORE NO. 4 12260.0' - 12320.0' (REC. 60.0') (16 BOXES)										
81	12260.0-61.1	1.1	0.41	0.39	0.13	0.45	1.5	1.65	2.81	2.86			SV F

CORE LABORATORIES - CANADA, LTD.

Company COLUMBIA GAS DEVELOPMENT OF CANADA LTD. Formation NAHANNI Page 4 of 11
Well COLUMBIA ET AL KOTANEELEE YT H-38 Drilling Fluid WATER BASE MUD File 7004-7571

Sample Number	Interval Represented, Feet		Permeability to Air, Millidarcys			Permeability Feet	Porosity, Per Cent	Porosity Feet	Density, gm./cc.		Residual Saturations, Per Cent Pore Space		Visual Examination
	Depth	Thick	K Max	K90°	KV				Bulk	Grain	Oil	Total Water	
			CORE NO. 4 CONTINUED										
82	12261.1-62.0	0.9	1.65	0.75	0.07	1.49	2.0	1.80	2.80	2.86			SV F
83	12262.0-63.2	1.2	13.10	10.40	0.56	15.72	2.3	2.76	2.79	2.86			SV F
84	12263.2-64.0	0.8	2.99	1.87	0.69	2.39	2.3	1.84	2.79	2.86			SV F
85	12264.0-65.0	1.0	7.10	2.33	0.34	7.10	1.8	1.80	2.80	2.86			SV F
86	12265.0-65.8	0.8	3.81	2.84	0.64	3.05	2.7	2.16	2.78	2.86			SV F
87	12265.8-66.7	0.9	5.64	3.64	0.24	5.08	2.5	2.25	2.79	2.86			SV F
88	12266.7-67.8	1.1	13.60	6.12	-0.01	14.96	2.5	2.75	2.83	2.90			SV F
89	12267.8-68.8	1.0	30.30	1.99	-0.01	30.30	2.7	2.70	2.78	2.86			SV F
90	12268.8-69.8	1.0	21.80	0.95	0.06	21.80	1.7	1.70	2.81	2.86			SV F
91	12269.8-70.7	0.9	1.24	0.98	0.05	1.12	2.5	2.25	2.81	2.89			SV F
92	12270.7-71.7	1.0	3.61	1.31	0.12	3.61	1.4	1.40	2.81	2.85			SV F
93	12271.7-72.6	0.9	10.30	5.76	0.05	9.27	1.5	1.35	2.81	2.85			SV F
94	12272.6-73.5	0.9	0.89	0.82	0.94	0.80	1.2	1.08	2.82	2.86			SV F
95	12273.5-74.4	0.9	60.30	18.20	0.40	54.27	3.1	2.79	2.77	2.86			SV F
96	12274.4-75.4	1.0	0.57	0.36	-0.01	0.57	1.1	1.10	2.82	2.85			SV F
97	12275.4-76.1	0.7	0.71	0.52	0.04	0.49	4.0	2.80	2.74	2.86			SV F
98	12276.1-76.9	0.8	1.57	1.22	-0.01	1.26	1.0	0.80	2.82	2.85			SV F
99	12276.9-78.3	1.4	3.90	1.53	0.81	5.46	3.8	5.32	2.75	2.86			SV VF
100	12278.3-79.2	0.9	0.95	0.61	-0.01	0.85	0.4	0.36	2.85	2.87			DENSE F
101	12279.2-79.9	0.7	5.88	0.04	0.15	4.12	2.4	1.68	2.79	2.86			SV F
102	12279.9-81.0	1.1	0.93	0.68	0.95	1.03	1.4	1.54	2.82	2.86			SV F
103	12281.0-82.0	1.0	0.11	0.08	0.12	0.11	0.9	0.90	2.84	2.86			SV F
104	12282.0-82.0	1.0	5.06	3.09	0.42	5.06	4.5	4.50	2.73	2.86			SV F
105	12283.0-84.1	1.1	0.94	0.86	0.10	1.03	2.4	2.64	2.79	2.86			SV F
106	12284.1-84.9	0.8	58.00	9.05	1.03	46.40	3.8	3.04	2.75	2.86			SV F
107	12284.9-86.3	1.4	26.70	24.40	0.05	37.38	0.9	1.26	2.83	2.86			DENSE F
-	12286.3-91.4	5.1	-	-	-	-	-	-	-	-			DENSE
108	12291.4-92.8	1.4	0.68	0.68	0.98	0.96	1.4	1.96	2.82	2.86			I F
109	12292.8-94.5	1.7	0.63	0.29	0.11	1.07	1.2	1.20	2.83	2.87			I F
110	12294.5-95.1	0.6	3.06	0.73	0.26	1.84	3.0	1.80	2.78	2.87			SV F
-	12295.1-96.3	1.2	-	-	-	-	-	-	-	-			DENSE
111	12296.3-96.9	0.6	0.08	0.05	-0.01	0.05	3.8	2.28	2.75	2.86			SV F
112	12296.9-98.0	1.1	12.30	1.02	0.10	13.53	1.2	1.32	2.83	2.87			DENSE F

CORE LABORATORIES - CANADA, LTD.

Company COLUMBIA GAS DEVELOPMENT OF CANADA LTD. Formation NAHANNI Page 5 of 11
Well COLUMBIA ET AL KOTANEELEE YT H-38 Drilling Fluid WATER BASE MUD File 7004-7571

Sample Number	Interval Represented, Feet		Permeability to Air, Millidarcys			Permeability Feet	Porosity, Per Cent	Porosity Feet	Density, gm./cc.		Residual Saturations, Per Cent Pore Space		Visual Examination
	Depth	Thick	K Max	K90°	KV				Bulk	Grain	Oil	Total Water	
			CORE NO. 4 CONTINUED										
113	12298.0-98.7	0.7	1.67	1.52	-0.01	1.17	4.6	3.22	2.72	2.86			SV F
114	12298.7-99.5	0.8	25.50	13.50	0.23	20.40	7.8	6.24	2.64	2.87			SV F
115	12299.5-00.5	1.0	3.56	1.09	0.28	3.56	3.7	3.70	2.75	2.86			SV F
116	12300.5-01.4	0.9	0.36	0.26	0.33	0.32	2.7	2.43	2.78	2.86			SV F
117	12301.4-02.3	0.9	2.09	1.41	0.79	1.88	1.5	1.35	2.81	2.86			SV F
-	12302.3-05.5	3.2	-	-	-	-	-	-	-	-			DENSE
118	12305.5-07.5	2.0	7.02	1.05	0.46	14.04	1.3	2.60	2.82	2.86			SV F
-	12307.5-08.7	1.2	-	-	-	-	-	-	-	-			DENSE
119	12308.7-10.2	1.5	4.78	1.93	0.66	7.17	1.2	1.80	2.83	2.86			I F
120	12310.2-11.5	1.3	4.76	2.89	1.27	6.19	1.9	2.47	2.80	2.86			SV F
121	12311.5-13.0	1.5	11.80	7.21	0.58	17.70	3.5	5.25	2.76	2.86			SV F
122	12313.0-14.2	1.2	1.88	0.87	0.23	2.26	4.3	5.16	2.73	2.85			SV F
123	12314.2-15.3	1.1	0.77	0.56	0.42	0.85	3.4	3.74	2.75	2.85			SV F
124	12315.3-16.2	0.9	108.00	9.61	1.28	97.20	7.4	6.66	2.65	2.86			SV F
125	12316.2-17.2	1.0	*	6.43	*	6.43	2.9	2.90	2.77	2.86			SV OVF
126	12317.2-18.6	1.4	10.60	4.82	1.59	14.84	2.5	3.50	2.79	2.86			SV F
127	12318.6-20.0	1.4	27.00	13.20	3.41	37.80	6.4	8.96	2.67	2.86			SV F
-	12320.0-50.0	130.0	-	-	-	-	-	-	-	-			DRILLED
			CORE NO. 5 12450.0' - 12510.0' (REC. 60.0') (17 BOXES)										
128	12450.0-51.6	1.6	22.10	6.58	10.10	35.36	2.9	4.64	2.78	2.86			SV F
129	12451.6-52.8	1.2	14.80	6.89	1.23	17.76	3.3	3.96	2.76	2.86			SV F
130	12452.8-53.8	1.0	105.00	21.90	0.70	105.00	2.9	2.90	2.77	2.86			SV F
131	12453.8-54.7	0.9	3.60	2.25	0.50	3.24	2.7	2.43	2.77	2.85			SV F
132	12454.7-55.7	1.0	86.00	19.80	0.47	86.00	3.6	3.60	2.75	2.85			SV F
133	12455.7-56.3	0.6	18.10	3.50	1.49	10.86	5.2	3.12	2.72	2.87			SV F
134	12456.3-57.3	1.0	8.97	4.89	0.74	8.97	3.2	3.20	2.76	2.86			SV F
135	12457.3-58.5	1.2	3.49	3.49	1.56	4.19	3.1	3.72	2.75	2.85			SV F
136	12458.5-59.3	0.8	5.41	3.94	1.38	4.33	3.4	2.72	2.75	2.85			SV F
137	12459.3-60.5	1.2	2.84	2.34	1.08	3.41	3.4	4.08	2.76	2.86			SV F
138	12460.5-61.6	1.1	7.34	5.92	3.08	8.07	2.6	2.86	2.77	2.85			SV F
139	12461.6-62.7	1.1	42.70	11.80	1.85	46.97	3.0	3.30	2.77	2.85			SV F

FORM NO. 50A

Company COLUMBIA GAS DEVELOPMENT OF CANADA LTD.
Well COLUMBIA ET AL KOTANEELEE YT H-38
Formation NAHANNI
Drilling Fluid WATER BASE MUD

File 7004-7571

Sample Number	Interval Represented, Feet		Permeability to Air, Millidarcys			Permeability Feet	Porosity, Per Cent	Porosity Feet	Density, gm./cc.		Residual Saturations, Per Cent Pore Space		Visual Examination
	Depth	Thick	K Max	K90°	KV				Bulk	Grain	Oil	Total Water	
			CORE NO. 5 CONTINUED										
140	12462.7-63.3	0.6	3.87	2.66	2.13	2.32	3.5	2.10	2.75	2.85			SV F
141	12463.3-64.4	1.1	2.84	1.87	1.08	3.12	4.2	4.62	2.73	2.85			SV F
142	12464.4-65.6	1.2	2.13	1.75	0.91	2.56	3.5	4.20	2.76	2.86			SV F
143	12465.6-66.6	1.0	2.21	0.63	1.90	2.21	2.8	2.80	2.77	2.85			SV F
144	12466.6-67.5	0.9	4.37	3.43	4.43	3.93	3.1	2.79	2.77	2.86			SV F
145	12467.5-68.5	1.0	5.03	4.43	3.45	5.03	4.2	4.20	2.74	2.86			SV F
146	12468.5-69.5	1.0	**	3.42	0.81	3.42	4.7	4.70	2.72	2.86			LV SV F
147	12469.5-70.5	1.0	0.88	0.80	0.36	0.88	3.3	3.30	2.76	2.86			SV F
148	12470.5-71.4	0.9	3.33	2.70	1.13	3.00	4.1	3.69	2.74	2.85			SV F
149	12471.4-72.2	0.8	1.34	1.11	0.23	1.07	2.9	2.32	2.78	2.86			SV F
150	12472.2-73.0	0.8	8.00	5.15	1.09	6.40	3.5	2.80	2.76	2.86			SV F
151	12473.0-73.8	0.8	56.10	40.60	0.46	44.88	2.3	1.84	2.79	2.86			PPV F
-	12473.8-76.4	2.6	-	-	-	-	-	-	-	-			DENSE
152	12476.4-77.1	0.7	10.80	8.34	0.30	7.56	2.9	2.03	2.79	2.88			SV F
-	12477.1-78.7	1.6	-	-	-	-	-	-	-	-			DENSE
153	12478.7-80.1	1.4	**	0.51	23.00	0.71	5.0	7.00	2.72	2.86			LV SV F
-	12480.1-82.2	2.1	-	-	-	-	-	-	-	-			DENSE
154	12482.2-83.3	1.1	7.82	2.16	1.22	8.60	3.2	3.52	2.77	2.87			SV F
155	12483.3-84.3	1.0	2.11	2.07	12.00	2.11	2.7	2.70	2.77	2.85			I VF
156	12484.3-85.2	0.9	4.79	2.47	2.30	4.31	3.3	2.97	2.77	2.87			SV F
157	12485.2-86.2	1.0	7.98	4.87	3.17	7.98	2.9	2.90	2.78	2.86			SV F
158	12486.2-87.1	0.9	9.92	7.16	0.59	8.93	2.5	2.25	2.79	2.86			SV F
159	12487.1-87.9	0.8	12.40	8.07	2.13	9.92	2.5	2.00	2.77	2.85			SV PPV F
160	12487.9-88.8	0.9	5.47	5.36	1.89	4.92	3.3	2.97	2.76	2.86			SV F
161	12488.8-89.8	1.0	40.30	30.70	3.33	40.30	3.1	3.10	2.76	2.85			SV F
162	12489.8-90.6	0.8	22.60	22.60	3.29	18.08	3.3	2.64	2.76	2.86			SV F
163	12490.6-91.5	0.9	25.70	16.00	1.30	23.13	6.5	5.85	2.67	2.86			SV F
164	12491.5-92.4	0.9	60.40	26.50	4.52	54.36	3.3	2.97	2.76	2.85			SV F
165	12492.4-93.3	0.9	6.61	3.87	2.37	5.95	2.9	2.61	2.77	2.86			SV F
166	12493.3-94.2	0.9	2.47	1.55	0.28	2.22	3.3	2.97	2.76	2.85			SV F
167	12494.2-95.4	1.2	5.46	3.14	1.48	6.55	2.7	3.24	2.78	2.85			SV F
168	12495.4-96.6	1.2	43.80	9.56	4.35	52.56	1.5	1.80	2.82	2.87			SV VF

Company COLUMBIA GAS DEVELOPMENT OF CANADA LTD.
Well COLUMBIA ET AL KOTANEELEE YT H-38
Formation NAHANNI
Drilling Fluid WATER BASE MUD

File 7004-7571

Sample Number	Interval Represented, Feet		Permeability to Air, Millidarcys			Permeability Feet	Porosity, Per Cent	Porosity Feet	Density, gm./cc.		Residual Saturations, Per Cent Pore Space		Visual Examination
	Depth	Thick	K Max	K90°	KV				Bulk	Grain	Oil	Total Water	
			CORE NO. 5 CONTINUED										
169	12496.6-98.2	1.6	21.20	19.10	45.70	33.92	2.3	3.68	2.79	2.86			PPV VF
170	12498.2-99.1	0.9	5.06	3.78	2.09	4.55	1.4	1.26	2.81	2.86			I F
-	12499.1-04.9	5.8	-	-	-	-	-	-	-	-			DENSE
171	12504.9-05.9	1.0	2.97	0.56	0.04	2.97	0.2	0.20	2.85	2.86			DENSE F
172	12505.9-06.7	0.8	14.40	9.18	3.69	11.52	2.3	1.84	2.79	2.86			SV F
173	12506.7-07.7	1.0	10.50	8.03	1.07	10.50	2.5	2.50	2.78	2.85			SV F
174	12507.7-08.7	1.0	21.60	18.60	2.72	21.60	2.7	2.70	2.78	2.86			SV F
175	12508.7-10.0	1.3	4.59	4.48	3.97	5.97	3.3	4.29	2.76	2.86			SV VF
-	12510.0-08.0	198.0	-	-	-	-	-	-	-	-			DRILLED

COMPANY COLUMBIA GAS DEVELOPMENT OF CANADA LTD.
WELL COLUMBIA ET AL KOTANEELEE YT H-38
FIELD KOTANEELEE, NORTHWEST TERRITORIES
LOCATION 60° 07' 16" N.L. 124° 06' 03" W.L.

FORMATION NAHANNI
DRILLING FLUID WATER BASE MUD
ELEVATION
ANALYSIS FULL DIAMETER
REMARKS

FILE 7004-7571
DATE REPORT NOV. 21/77
ANALYSTS BK JL JC TE MW CP

ABT - APPEARS SIMILAR TO
B - BROKEN CORE (K90 USED FOR SUMMARY PURPOSES)
** - PERMEABILITY > 30000 MD.
- - PERMEABILITY <
FS - FINE SAND
MS - MEDIUM SAND
CS - COARSE SAND
CONG - CONGLOMERATE
DOL - DOLOMITE
SH - SHALE
LMY - LIMY
SHY - SHALY
/BK - BREAK
BIT - PYROBITUMEN
CARB - CARBONACEOUS
A - ANHYDRITE
FOSS - FOSSILIFEROUS
XLN - CRYSTALLINE
LAM - LAMINATIONS
V - VUGULAR
LV - LARGE VUGS
SV - SMALL VUGS
PPV - PIN POINT VUGS
I - INTERGRANULAR
STY - STYLOLITIC
HF - HORIZONTAL FRACTURE
VF - VERTICAL FRACTURE
SM - SMALL PLUG SAMPLE
SL - SLIGHTLY
VI - VERY
W - WITH

SAMPLE NUMBER	INTERVAL REPRESENTED, FEET		PERMEABILITY TO AIR, MILLIDARCYS			PERMEABILITY FEET	POROSITY, PER CENT	POROSITY FEET	DENSITY, gm./cc.		VISUAL EXAMINATION
	DEPTH	THICK	KMAX	K90°	KV				BULK	GRAIN	
	CORE NO. 6 12708.0' - 12755.0' (REC. 47.0') (13 BOXES)										
176	12708.0-09.3	1.3	1.54	1.16	-0.01	2.00	6.3	8.19	2.66	2.84	FEW LV SV PPV I A
177	12709.3-10.0	0.7	-0.01	-0.01	-0.0.	-	1.2	0.84	2.85	2.88	I A
178	12710.0-11.0	1.0	0.01	0.01	-0.01	0.01	1.0	1.00	2.82	2.85	I A
179	12711.0-11.8	0.8	-0.01	-0.01	-0.01	-	1.0	0.80	2.84	2.87	FEW PPV I A
180	12711.8-13.2	1.4	0.01	0.01	-0.01	0.01	2.2	3.08	2.79	2.85	I A
181	12713.2-14.8	1.6	0.05	0.02	-0.01	0.08	2.3	3.68	2.78	2.85	I A
182	12714.8-16.2	1.4	0.03	0.02	-0.01	0.04	3.6	5.04	2.77	2.88	I A
183	12716.2-17.6	1.4	1.48	0.70	-0.01	2.07	2.0	2.80	2.81	2.87	SV PPV I A
184	12717.6-18.9	1.3	1.00	1.00	0.44	1.30	1.7	2.21	2.81	2.86	FEW LV SV PPV CALCITE A
185	12718.9-19.9	1.0	3.56	2.87	0.32	3.56	2.5	2.50	2.80	2.87	SV PPV I A STY
186	12719.9-20.4	0.5	1.99	1.72	0.37	1.00	2.4	1.20	2.79	2.86	FEW LV SV PPV A
187	12720.4-21.8	1.4	0.10	0.01	-0.01	0.14	1.1	1.54	2.83	2.86	I A
188	12721.8-23.2	1.4	0.01	-0.01	-0.01	0.01	0.9	1.26	2.82	2.85	I
189	12723.2-24.4	1.2	1.42	0.14	-0.01	1.70	2.4	2.88	2.81	2.88	FEW PPV I A STY
190	12724.4-25.3	0.9	1.14	0.36	0.86	1.03	2.2	1.98	2.80	2.86	FEW LV SV PPV A VF
191	12725.3-26.2	0.9	4.16	3.89	1.63	3.74	4.2	3.78	2.73	2.85	FEW LV SV PPV A
192	12726.2-27.2	1.0	1.79	1.32	0.95	1.79	2.8	2.80	2.74	2.82	FEW LV SV PPV A
193	12727.2-28.6	1.4	0.88	0.80	-0.01	1.23	1.0	1.40	2.82	2.84	SV PPV A
194	12728.6-30.5	1.9	0.92	0.81	-0.01	1.75	1.1	2.09	2.84	2.87	FEW SV PPV I A
195	12730.5-31.5	1.0	7.00	5.37	1.05	7.00	5.5	5.50	3.14	3.32	LV SV PPV A
196	12731.5-32.4	0.9	3.33	1.12	0.80	3.00	2.1	1.89	2.80	2.86	FEW SV PPV I A
197	12732.4-34.6	2.2	24.10	0.78	0.08	53.02	0.5	1.10	2.82	2.84	FEW SV I VF A
198	12734.6-36.0	1.4	0.46	0.45	0.22	0.64	1.9	2.66	2.81	2.86	SV PPV I A
199	12736.0-37.4	1.4	1.25	1.09	0.42	1.75	3.2	4.48	2.74	2.83	LV SV PPV A
200	12737.4-38.8	1.4	4.98	4.70	1.90	6.97	1.9	2.66	2.80	2.86	SV PPV I A
201	12738.8-39.5	0.7	16.40	16.40	0.36	11.48	2.9	2.03	2.75	2.83	FEW LV SV PPV A
202	12739.5-40.9	1.4	1.53	1.16	-0.01	2.14	1.7	2.38	2.81	2.86	SV PPV I A

COMPANY COLUMBIA GAS DEVELOPMENT OF CANADA LTD.
WELL COLUMBIA ET AL KOTANEELEE YT H-38

FILE 7004-7571

SAMPLE NUMBER	INTERVAL REPRESENTED, FEET		PERMEABILITY TO AIR, MILLIDARCYS			PERMEABILITY FEET	POROSITY, PER CENT	POROSITY FEET	DENSITY, gm./cc		VISUAL EXAMINATION
	DEPTH	THICK	KMAX	K90°	KV				BULK	GRAIN	
			CORE NO. 6 CONTINUED								
AST 202	12740.9-42.1	1.2	1.53	1.16	-0.01	1.84	1.7	2.04	2.81	2.86	SV PPV I A
203	12742.1-43.3	1.2	*	4.16	*	4.99	12.9	15.48	2.48	2.85	LV SV PPV OVF A
204	12743.3-43.7	0.4	7.30	6.57	0.06	2.92	0.5	0.20	2.83	2.84	FEW PPV I A
205	12743.7-44.4	0.7	1.08	0.70	-0.01	0.76	1.3	0.91	2.83	2.87	SV PPV I STY PYRITE A
206	12744.4-45.4	1.0	1.70	1.37	-0.01	1.70	1.2	1.20	2.82	2.86	FEW SV PPV I PYRITE A
207	12745.4-46.3	0.9	0.63	0.42	0.07	0.57	1.6	1.44	2.81	2.86	FEW PPV I STY A
208	12746.3-47.3	1.0	5.55	1.39	0.36	5.55	0.9	0.90	2.83	2.85	FEW PPV I STY VF A
209	12747.3-48.3	1.0	0.73	0.51	0.04	0.73	2.1	2.10	2.81	2.87	FEW PPV I A
210	12748.3-49.0	0.7	6.38	3.89	0.06	4.47	0.6	0.42	2.82	2.84	FEW SV PPV I A
211	12749.0-50.3	1.3	9.65	9.13	0.11	12.55	6.5	8.45	2.66	2.84	LV SV PPV A
212	12750.3-51.8	1.5	8808.00	2.56	0.21	13212.00	4.6	6.90	2.72	2.85	LV SV PPV A
213	12751.8-52.9	1.1	**	3.25	0.21	3.58	8.4	9.24	2.60	2.84	LV SV PPV A
214	12752.9-53.4	0.5	1.12	1.02	0.15	0.56	1.6	0.80	2.82	2.87	FEW SV PPV I A
215	12753.4-55.0	1.6	*	17.10	5.06	27.36	0.3	0.48	2.83	2.84	I A HF
			CORE NO. 7 12755.0' - 12789.0 (REC. 34.0') (10 BOXES)								
216	12755.0-56.9	1.9	0.08	0.02	-0.01	0.15	0.9	1.71	2.82	2.85	I A
217	12756.9-58.8	1.9	0.03	0.01	-0.01	0.06	2.4	4.56	2.82	2.89	I A
218	12758.8-60.7	1.9	1.78	1.09	-0.01	3.38	2.7	5.13	2.78	2.86	FEW SV I HF A
219	12760.7-62.4	1.7	0.07	0.03	1.23	0.12	1.9	3.23	2.82	2.87	I VF A
220	12762.4-63.0	0.6	3.37	1.25	0.22	2.02	4.8	2.88	2.72	2.86	FEW LV SV PPV STY A
221	12763.0-63.8	0.8	6.75	2.90	0.34	5.40	1.3	1.04	2.82	2.86	SV PPV I A
222	12763.8-64.4	0.6	5.09	0.57	0.36	3.05	1.6	0.96	2.81	2.86	SV PPV I A
223	12764.4-65.8	1.4	2.41	0.83	-0.01	3.37	1.2	1.68	2.83	2.86	FEW SV PPV I A
224	12765.8-66.3	0.5	1.59	1.31	0.09	0.80	1.3	0.65	2.82	2.86	FEW SV PPV I A
225	12766.3-66.9	0.6	12.20	1.70	0.06	7.32	2.1	1.26	2.80	2.86	FEW LV SV PPV HF A
226	12766.9-67.7	0.8	0.50	0.37	-0.01	0.40	3.4	2.72	2.76	2.86	FEW LV SV PPV A
227	12767.7-68.3	0.6	0.68	0.64	0.05	0.41	1.1	0.66	2.84	2.87	FEW PPV I STY A

COMPANY COLUMBIA GAS DEVELOPMENT OF CANADA LTD.
WELL COLUMBIA ET AL KOTANEELEE YT H-38

SAMPLE NUMBER	INTERVAL REPRESENTED, FEET		PERMEABILITY TO AIR, MILLIDARCYS			PERMEABILITY FEET	POROSITY, PER CENT	POROSITY FEET	DENSITY, gm./cc		VISUAL EXAMINATION
	DEPTH	THICK	KMAX	K90°	KV				BULK	GRAIN	
			CORE NO. 7 CONTINUED								
228	12768.3-69.0	0.7	1.54	1.12	0.15	1.08	1.3	0.91	2.78	2.82	FEW LV PPV I A
229	12769.0-70.0	1.0	2.33	0.93	0.15	2.33	1.5	1.50	2.79	2.83	SV PPV I A
230	12770.0-71.0	1.0	23.60	18.30	-0.01	23.60	1.3	1.30	2.83	2.86	FEW SV PPV I HF A
231	12771.0-71.8	0.8	2.10	2.10	0.13	1.68	1.6	1.28	2.82	2.86	SV PPV I STY A
232	12771.8-72.4	0.6	1.76	0.71	0.37	1.06	1.7	1.02	2.81	2.86	FEW PPV I STY A
233	12772.4-73.2	0.8	4.14	2.16	0.17	3.31	1.8	1.44	2.82	2.87	FEW LV SV PPV I A
234	12773.2-74.0	0.8	2.10	1.32	1.49	1.68	1.8	1.44	2.82	2.87	FEW LV SV PPV I A
235	12774.0-75.0	1.0	2.00	1.53	0.96	2.00	0.2	0.20	2.82	2.83	FEW PPV I A
236	12775.0-75.8	0.8	*	0.35	*	0.28	0.2	0.16	2.81	2.82	FEW SV I OVF A
237	12775.8-76.6	0.8	0.61	0.56	0.31	0.49	1.6	1.28	2.81	2.85	SV PPV I A
238	12776.6-77.3	0.7	1.10	0.85	0.31	0.77	2.4	1.68	2.80	2.87	SV PPV I A
239	12777.3-77.9	0.6	*	1.07	*	0.64	3.8	2.28	2.77	2.88	SV PPV I OVF A
240	12777.9-78.6	0.7	0.61	0.39	0.36	0.43	3.9	2.73	2.71	2.83	FEW LV SV PPV I A
241	12778.6-79.6	1.0	0.93	0.50	0.06	0.93	5.5	5.50	2.70	2.86	LV SV PPV A
242	12779.6-80.3	0.7	2.27	1.86	0.70	1.59	4.7	3.29	2.72	2.86	LV SV PPV I A
243	12780.3-81.2	0.9	30720.00	1.71	1.09	27648.00	3.4	3.06	2.73	2.83	LV SV PPV I A
244	12781.2-82.4	1.2	**	9.60	0.76	11.52	4.5	5.40	2.67	2.80	LV SV PPV I CALCITE A
245	12782.4-83.5	1.1	0.70	0.66	0.17	0.77	2.0	2.20	2.76	2.82	FEW LV SV PPV I CALCITE A
246	12783.5-84.6	1.1	9.10	2.73	0.14	10.01	2.5	2.75	2.76	2.83	LV SV PPV I A
247	12784.6-85.7	1.1	28.80	11.60	*	31.68	3.2	3.52	2.73	2.82	SV PPV I STY A
248	12785.7-86.4	0.7	73.70	41.90	1.25	51.59	3.3	2.31	2.75	2.84	LV SV PPV A
249	12786.4-87.7	1.3	**	12.80	1.12	16.64	1.7	2.21	2.77	2.82	LV SV PPV I A
250	12787.7-89.0	1.3	1.02	0.92	0.06	1.33	3.3	4.29	2.77	2.86	SV PPV I A

CORE LABORATORIES – CANADA, LTD.

Petroleum Reservoir Engineering

WELL: COLUMBIA ET AL KOTANELEE YT H-38

PAGE: 11 of 11

FORMATION: NAHANNI

SUMMARY INTERVAL: 11690.0 - 12789.0

FILE: 7004-7571

TOTAL FOOTAGE: 1099.0

FOOTAGE ANALYZED 259.2

FOOTAGE NOT ANALYZED: TOTAL: 839.8 DENSE 22.8 LOST 3.0 DRILLED 814.0 *NABR 0.0 RUBBLE 0.0

SUMMARY OF ANALYZED CORE:

	FOOTAGE	% OF ANALYZED CORE	WEIGHTED AVERAGE POROS. %	POROSITY FEET	WEIGHTED AVERAGE PERM. MD.	PERM. FEET	WEIGHTED AVERAGE RESID. OIL %	WEIGHTED AVERAGE TOT. WATER %
TOTAL	259.2	100.0	2.8	720.87	168.87	43770.77	0.0	0.0
BY PERM RANGES:								
LESS THAN 0.10 Md.	16.8	6.5	2.4	41.10	0.04	0.70	0.0	0.0
0.10 0.49 Md.	23.1	8.9	1.7	39.23	0.29	6.59	0.0	0.0
0.50 0.99 Md.	36.1	13.9	2.1	75.71	0.72	25.99	0.0	0.0
1.00 9.99 Md.	126.5	48.8	3.1	388.60	3.65	462.12	0.0	0.0
GREATER THAN 9.99 Md.	56.7	21.9	3.1	176.23	763.23	43275.10	0.0	0.0

*NOT ANALYZED BY REQUEST

CHEMICAL & GEOLOGICAL LABORATORIES LTD.

EDMONTON — FORT ST. JOHN — CALGARY

— WATER ANALYSIS —

CONTAINER IDENTITY

LABORATORY NUMBER: F77-1738-3

OPERATOR NAME AND ADDRESS: COLUMBIA GAS DEVELOPMENT OF CANADA LTD.

SAMPLE LOCATION	WELL OR SAMPLE LOCATION NAME	ELEVATIONS KB	GRD.
60° 10' 124° 00'	COLUMBIA GAS ETAL KOTONEELEE H-38	2275'	2255'

FIELD OR AREA	POOL OR ZONE	NAME OF SAMPLER	COMPANY
KOTONEELEE	NAHANNI		JOHNSTON TESTERS

TEST TYPE & NO.	TEST RECOVERY
DST 5	802'

TEST INTERVAL OR PERFS	POINT OF SAMPLE	AMT. & TYPE OF CUSHION	MUD RESISTIVITY
11625' - 11890'	BOTTOM		@ °F

TYPE OF PRODUCTION: PUMPING | FLOWING | GAS LIFT | SWAB

PRODUCTION RATES: WATER BBLS/D | OIL BBLS/D | GAS MCF/D

PRESSURES - PSIG						TEMPERATURES (°F)				
SEPARATOR	TREATER		RESERVOIR	CONTAINER WHEN SAMPLED	CONTAINER WHEN RECEIVED	SEPARATOR	TREATER		CONTAINER WHEN SAMPLED	CONTAINER WHEN RECEIVED

DATE SAMPLED (D/M/Y)	DATE RECEIVED (D/M/Y)	DATE ANALYZED (D/M/Y)	ANALYST	REMARKS
04/10/77	05/10/77	06/10/77	G.G. L.F.	

ION	MG/L	MG%	MEQ/L
Na	20330	40.19	884.34
K			
Ca	5	0.01	0.27
Mg	1	0.00	0.06
Ba			
Sr			
Fe	NIL		

ION	MG/L	MG%	MEQ/L
Cl	18817	37.19	530.64
Br			
I			
HCO_3	NIL		
SO_4	4182	8.27	86.98
CO_3	6257	12.37	208.36
OH	998	1.97	58.69
H_2S	NIL		

TOTAL SOLIDS Mg/L

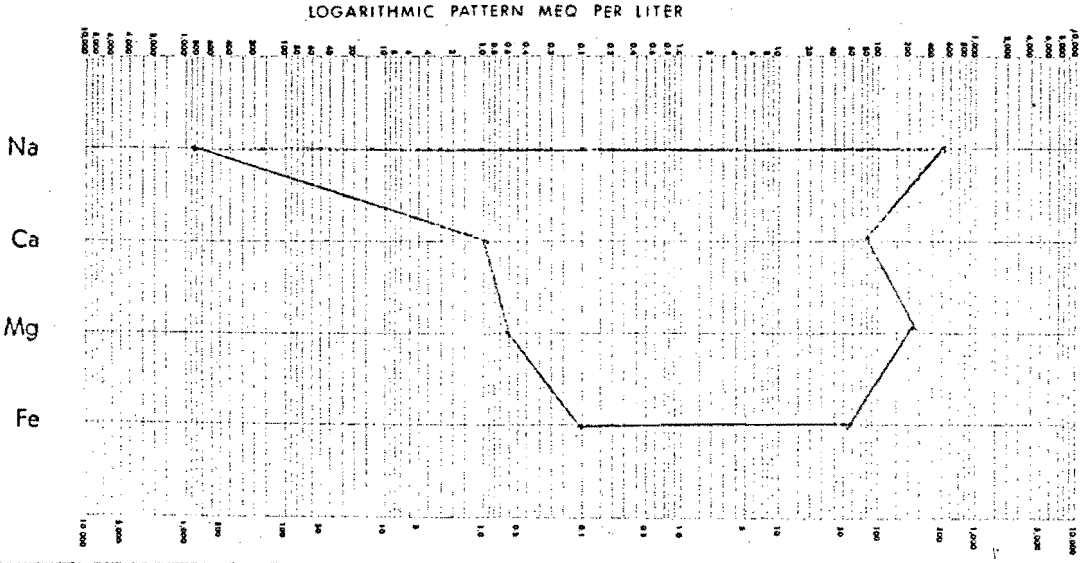
BY EVAPORATION	BY EVAPORATION
52740 @ 110°C	@ 180°C
AT IGNITION	**CALCULATED**
44690	50590

ORGANIC MATTER: MUCH

SPECIFIC GRAVITY	REFRACTIVE INDEX
1.035 @ 60°F	1.3415 @ 25°C

OBSERVED PH	RESISTIVITY (Ohm/meters)
11.0 @ 67 °F	0.145 @ 25°C

LOGARITHMIC PATTERN MEQ PER LITER



Remarks and Conclusions

Sample consisted of muddy water with a brown colored filtrate. Ammonia present in sample.

Continued...

COLUMBIA GAS DEVELOPMENT OF CANADA LTD. LABORATORY REPORT NUMBER: F77-1738

F77-1738-1: SAMPLED FROM TOP

RESISTIVITY: 0.195 Ohm/meters @ 25°C

Sample consisted of muddy water with a brown colored filtrate. Ammonia present in sample.

F77-1738-2: SAMPLED FROM MIDDLE

RESISTIVITY: 0.173 Ohm/meters @ 25°C

Sample consisted of muddy water with a brown colored filtrate. Ammonia present in sample.

F77-1738-4: DOWNHOLE SAMPLER #561

Johnston Testers downhole sampler #561 was received under atmospheric pressure. No recoverable gas or fluid present.

F77-1738-5: DOWNHOLE SAMPLER #556

Johnston Testers downhole sampler #556 was received under a pressure of 520 psig. Contained in the sample chamber was gas only. Gas analysis to follow.

CORE LABORATORIES - CANADA LTD.
Petroleum Reservoir Engineering
CALGARY ALBERTA

DST CHAMBER #521 — CONTAINER IDENTITY

GAS ANALYSIS

7012-7943A — LABORATORY NUMBER

Columbia Gas Development of Canada Ltd. — OPERATOR

1 of 2 — PAGE

60° 7'N.L. 124° 6' W.L. — LOCATION

Columbia et al Kotaneelee YT H-38 — WELL OR SAMPLE LOCATION NAME

2275' — KB ELEV.

2250' — GRD. ELEV.

Kotaneelee, Yukon Territories — FIELD OR AREA

POOL OR ZONE

Johnston Testers — SAMPLER

DST #1 — TEST TYPE & NO.

Tool: 500 mls Muddy Water — TEST RECOVERY

Down Hole MFE Chamber #521 — POINT OF SAMPLE

AMT. & TYPE CUSHION

@ °F — MUD RESISTIVITY

7725' - 7920' — TEST INTERVALS OR PERFS.

PUMPING FLOWING GAS LIFT SWAB

WATER BBLS/D. OIL BBLS/D. GAS MFC/D.

SEPARATOR RESERVOIR — PRESSURES, PSIG

@ °F — CONTAINER WHEN SAMPLED

725 @ 78°F — CONTAINER WHEN RECEIVED

SEPARATOR — TEMPERATURES, °F

Aug 10/77 — DATE SAMPLED (D/M/Y)

Sept 7/77 — DATE RECEIVED (D/M/Y)

Sept 7/77 — DATE ANALYSED (D/M/Y)

OR — ANALYST

REMARKS

COMPONENT	MOL % AIR FREE AS REC'D	MOL % AIR FREE ACID GAS FREE	CON. G.P.M. AIR FREE AS REC'D
H_2	0.01		
He	0.02		
N_2	0.46		
CO_2	0.12		
H_2S	0.00		
C_1	99.07		
C_2	0.31		
C_3	0.01		0.003
iC_4	0.00		0.000
C_4	0.00		0.000
iC_5	0.00		0.000
C_5	0.00		0.000
C_6	0.00		0.000
C_7+	0.00		0.000
TOTAL	100.00		0.003
		C_5+	0.000

GROSS HEATING VALUE
BTU/FT^3 @ 60°F & 14.65 PSIA

(MOISTURE & ACID GAS FREE)

MEASURED

1004.6 — CALCULATED

DEW POINT

0.0 — VAPOUR PRESS. PENTANES PLUS

SPECIFIC GRAVITY

MOISTURE FREE AS SAMPLED

MEASURED

0.558 — CALCULATED

MOISTURE AND ACID GAS FREE

MEASURED

CALCULATED

PSEUDOCRITICAL PROPERTIES (CALCULATED)

AS SAMPLED

672.7 PSIA — PPc

343.6 °R — PTc

ACID GAS FREE

PSIA — PPc

°F — PTc

REMARKS

CORE LABORATORIES - CANADA LTD
Petroleum Reservoir Engineering
CALGARY ALBERTA

CG 5395 SS — CONTAINER IDENTITY

GAS ANALYSIS

7012-7943 — LABORATORY NUMBER

Columbia Gas Development of Canada Ltd. — OPERATOR

1 of 3 — PAGE

60° 7' N.L. 124° 6' W.L. — LOCATION

Columbia et al Kotaneelee YT H-38 — WELL OR SAMPLE LOCATION NAME

2275' — KB ELEV.

2250' — GRD. ELEV.

Kotaneelee, Yukon Territories — FIELD OR AREA

POOL OR ZONE

Johnston Testers Ltd. — SAMPLER

DST #1 — TEST TYPE & NO.

1150' — TEST RECOVERY

Flareline — POINT OF SAMPLE

AMT. & TYPE CUSHION

@ °F — MUD RESISTIVITY

7725' - 7921' — TEST INTERVALS OR PERFS.

PUMPING FLOWING GAS LIFT SWAB

WATER BBLS/D. OIL BBLS/D. GAS MCF/D.

SEPARATOR RESERVOIR @ °F — CONTAINER WHEN SAMPLED

40 @ 80°F — CONTAINER WHEN RECEIVED

SEPARATOR

PRESSURES, PSIG — TEMPERATURES, °F

Aug 11/77 — DATE SAMPLED (D/M/Y)

Aug 19/77 — DATE RECEIVED (D/M/Y)

Aug 19/77 — DATE ANALYSED (D/M/Y)

OR — ANALYST

REMARKS

COMPONENT	MOL % AIR FREE AS REC'D	MOL % AIR FREE ACID GAS FREE	CDN. G.P.M. AIR FREE AS REC'D
H_2	0.00		
He	0.02		
N_2	1.08		
CO_2	1.52		
H_2S	0.00		
C_1	97.06		
C_2	0.30		
C_3	0.02		0.004
IC_4	Trace		0.000
C_4	Trace		0.001
IC_5	0.00		0.000
C_5	0.00		0.000
C_6	0.00		0.000
C_7+	0.00		0.000
TOTAL	100.00		0.005
		C_5+	0.000

GROSS HEATING VALUE
BTU/FT^3 @ 60°F & 14.65 PSIA

(MOISTURE & ACID GAS FREE)

MEASURED — CALCULATED: 998.5

DEW POINT — VAPOUR PRESS. PENTANES PLUS: 0.0

SPECIFIC GRAVITY

MOISTURE FREE AS SAMPLED — MEASURED — CALCULATED: 0.575

MOISTURE AND ACID GAS FREE — MEASURED — CALCULATED

PSEUDOCRITICAL PROPERTIES (CALCULATED)

AS SAMPLED: 677.2 PSIA pPc; 345.8 °R pTc

ACID GAS FREE: PSIA pPc; °F pTc

REMARKS

CORE LABORATORIES - CANADA LTD.
Petroleum Reservoir Engineering
CALGARY ALBERTA

GAS ANALYSIS

6445 SS — CONTAINER IDENTITY

7012-71139 — LABORATORY NUMBER

Columbia Gas Development of Canada Ltd. — OPERATOR

1 of 4 — PAGE

Columbia et al Kotaneelee YT H-38 — WELL OR SAMPLE LOCATION NAME

2250' — KB ELEV.

2225' — GRD. ELEV.

Kotaneelee, Yukon Territories — FIELD OR AREA

Nahanni — POOL OR ZONE

Johnston Testers — SAMPLER

DST #2 — TEST TYPE & NO.

755' Liquid — TEST RECOVERY

Flareline — POINT OF SAMPLE

AMT. & TYPE CUSHION

@ °F — MUD RESISTIVITY

11630' - 11690' — TEST INTERVALS OR PERFS.

PUMPING FLOWING GAS LIFT SWAB

WATER BBLS/D. OIL BBLS/D. GAS MFC/D.

SEPARATOR RESERVOIR — @ °F CONTAINER WHEN SAMPLED — 44 @80 °F CONTAINER WHEN RECEIVED — SEPARATOR

PRESSURES, PSIG — TEMPERATURES, °F

Sept. 28/77 — DATE SAMPLED (D/M/Y)

Oct. 11/77 — DATE RECEIVED (D/M/Y)

Oct. 11/77 — DATE ANALYSED (D/M/Y)

OR — ANALYST

REMARKS

COMPONENT	MOL % AIR FREE AS REC'D	MOL % AIR FREE ACID GAS FREE	CDN. G.P.M. AIR FREE AS REC'D
H_2	0.06		
He	0.04		
N_2	4.43		
CO_2	1.99		
H_2S	0.00		
C_1	93.46		
C_2	0.02		
C_3	0.00		0.000
iC_4	0.00		0.000
C_4	0.00		0.000
iC_5	0.00		0.000
C_5	0.00		0.000
C_6	0.00		0.000
C_7^+	0.00		0.000
TOTAL	100.00		0.000
		C_5+	0.000

GROSS HEATING VALUE
BTU/FT^3 @ 60°F & 14.65 PSIA

(MOISTURE & ACID GAS FREE)

MEASURED	CALCULATED	DEW POINT	VAPOUR PRESS. PENTANES PLUS
	960.9		0.0

SPECIFIC GRAVITY

MOISTURE FREE AS SAMPLED		MOISTURE AND ACID GAS FREE	
MEASURED	CALCULATED	MEASURED	CALCULATED
	0.591		

PSEUDOCRITICAL PROPERTIES (CALCULATED)

AS SAMPLED		ACID GAS FREE	
672.5 PSIA	342.0 °R	PSIA	°F
PPc	PTc	PPc	PTc

REMARKS

CORE LABORATORIES - CANADA LTD.
Petroleum Reservoir Engineering
CALGARY ALBERTA

GAS ANALYSIS

DST CHAMBER #103421 — CONTAINER IDENTITY

7012-71139 — LABORATORY NUMBER

Columbia Gas Development of Canada Ltd. — OPERATOR

2 of 4 — PAGE

Columbia et al Kotaneelee YT H-38 — WELL OR SAMPLE LOCATION NAME

2250' — KB ELEV.

2225' — GRD. ELEV.

Kotaneelee, Yukon Territories — FIELD OR AREA

Nahanni — POOL OR ZONE

Johnston Testers — SAMPLER

DST #2 — TEST TYPE & NO.

DST: 755' Liquid TOOL: No Fluid Recovered — TEST RECOVERY

MFE Chamber 103421 — POINT OF SAMPLE

AMT. & TYPE CUSHION

@ °F — MUD RESISTIVITY

11630' - 11690' — TEST INTERVALS OR PERFS.

PUMPING FLOWING GAS LIFT SWAB

WATER BBLS/D. OIL BBLS/D. GAS MFC/D.

SEPARATOR RESERVOIR — @ °F CONTAINER WHEN SAMPLED — 1 @ 76°F CONTAINER WHEN RECEIVED — SEPARATOR

PRESSURES, PSIG — TEMPERATURES, °F

Sept. 28/77 — DATE SAMPLED (D/M/Y)

Oct. 11/77 — DATE RECEIVED (D/M/Y)

Oct. 13/77 — DATE ANALYSED (D/M/Y)

OR — ANALYST

REMARKS

COMPONENT	MOL % AIR FREE AS REC'D	MOL % AIR FREE ACID GAS FREE	CDN. G.P.M. AIR FREE AS REC'D
H_2	0.60		
He	0.04		
N_2	12.36		
CO_2	1.87		
H_2S	0.00		
C_1	85.11		
C_2	0.02		
C_3	0.00		0.000
iC_4	0.00		0.000
C_4	0.00		0.000
iC_5	0.00		0.000
C_5	0.00		0.000
C_6	0.00		0.000
C_7+	0.00		0.000
TOTAL	100.00		0.000
		C_5+	0.000

GROSS HEATING VALUE
BTU/FT^3 @ 60°F & 14.65 PSIA

(MOISTURE & ACID GAS FREE)

MEASURED	CALCULATED	DEW POINT	VAPOUR PRESS. PENTANES PLUS
	875.9		0.0

SPECIFIC GRAVITY

MOISTURE FREE AS SAMPLED		MOISTURE AND ACID GAS FREE	
MEASURED	CALCULATED	MEASURED	CALCULATED
	0.620		

PSEUDOCRITICAL PROPERTIES (CALCULATED)

AS SAMPLED		ACID GAS FREE	
655.1 PSIA	331.0 °R	PSIA	°F
PPc	PTc	PPc	PTc

REMARKS

CORE LABORATORIES - CANADA LTD.
Petroleum Reservoir Engineering
CALGARY ALBERTA

GAS ANALYSIS

DST CHAMBER #110267 — CONTAINER IDENTITY

7012-71139 — LABORATORY NUMBER

Columbia Gas Development of Canada Ltd. — OPERATOR

3 of 4 — PAGE

Columbia et al Kotaneelee YT H-38 — WELL OR SAMPLE LOCATION NAME

LOCATION

2250' — KB ELEV.

2225' — GRD. ELEV.

Kotaneelee, Yukon Territories — FIELD OR AREA

Nahanni — POOL OR ZONE

Johnston Testers — SAMPLER

DST #2 — TEST TYPE & NO.

DST: 755' Liquid TOOL: No Fluid Recovered — TEST RECOVERY

MFE Chamber 110267 — POINT OF SAMPLE

AMT. & TYPE CUSHION

@ °F — MUD RESISTIVITY

11630' - 11690' — TEST INTERVALS OR PERFS.

PUMPING FLOWING GAS LIFT SWAB

WATER BBLS/D. OIL BBLS/D. GAS MFC/D.

SEPARATOR RESERVOIR — @ °F CONTAINER WHEN SAMPLED — 40 @ 80 °F CONTAINER WHEN RECEIVED — SEPARATOR

PRESSURES, PSIG — TEMPERATURES, °F

Sept. 28/77 — DATE SAMPLED (D/M/Y)

Oct. 11/77 — DATE RECEIVED (D/M/Y)

Oct. 12/77 — DATE ANALYSED (D/M/Y)

OR — ANALYST

REMARKS

COMPONENT	MOL % AIR FREE AS REC'D	MOL % AIR FREE ACID GAS FREE	CDN. G.P.M. AIR FREE AS REC'D
H_2	0.92		
He	0.05		
N_2	3.24		
CO_2	13.70		
H_2S	0.14		
C_1	81.94		
C_2	0.01		
C_3	0.00		0.000
iC_4	0.00		0.000
C_4	0.00		0.000
iC_5	0.00		0.000
C_5	0.00		0.000
C_6	0.00		0.000
C_7^+	0.00		0.000
TOTAL	100.00		0.000
		C_5+	0.000

GROSS HEATING VALUE
BTU/FT³ @ 60°F & 14.65 PSIA

(MOISTURE & ACID GAS FREE)

MEASURED	CALCULATED	DEW POINT	VAPOUR PRESS. PENTANES PLUS
	961.3		0.0

SPECIFIC GRAVITY

MOISTURE FREE AS SAMPLED		MOISTURE AND ACID GAS FREE	
MEASURED	CALCULATED	MEASURED	CALCULATED
	0.696		

PSEUDOCRITICAL PROPERTIES (CALCULATED)

AS SAMPLED		ACID GAS FREE	
pPc	pTc	pPc	pTc
718.1 PSIA	365.3 °R	PSIA	°R

REMARKS

CORE LABORATORIES · CANADA LTD.
Petroleum Reservoir Engineering
CALGARY ALBERTA

Plastic (CONTAINER IDENTITY)			7012-71139 (LABORATORY NUMBER)
	Columbia Gas Development of Canada Ltd. (OPERATOR)		4 of 4 (PAGE)
(LOCATION)	Columbia et al Kotaneelee YT H-38 (WELL OR SAMPLE LOCATION NAME)	2250' (KB ELEV.)	2225' (GRD. ELEV.)
Kotaneelee, Yukon Territories (FIELD OR AREA)	Nahanni (POOL OR ZONE)	Johnston Testers (SAMPLER)	
DST #2 (TEST TYPE & NO.)	755' Liquid (TEST RECOVERY)		
(POINT OF SAMPLE)	(AMT. & TYPE CUSHION)	@ °F (MUD RESISTIVITY)	
11630' - 11690' (TEST INTERVALS OR PERFS.)	PUMPING FLOWING GAS LIFT SWAB		
	WATER BBLS/D. OIL BBLS/D. GAS MFC/D.		
SEPARATOR RESERVOIR	@ °F (CONTAINER WHEN SAMPLED)	@ °F (CONTAINER WHEN RECEIVED)	SEPARATOR
PRESSURES, PSIG			TEMPERATURES, °F

Sept. 28/77 (DATE SAMPLED (D/M/Y))	Oct. 11/77 (DATE RECEIVED (D/M/Y))	Oct. 24/77 (DATE ANALYSED (D/M/Y))	LES (ANALYST)	(REMARKS)

ANALYSIS

Resistivity = 0.0160 Ohm-meters @ 25°C

Chloride = 18,644 mg/liter

REMARKS: Insufficient sample to perform a routine analysis.

SECTION VI

Completion Summary

D&S PETROLEUM CONSULTANTS LTD.

TUBING SUMMARY

73F 3

Well COLUMBIA ET AL KOTANEELEE YT H38 Date Oct 28/77

KB Elevation 2250 KB to CSG FLG 2225 KB to TBG TOP 21

Casing OD 7" WT 32# & 29# MIN DIA 5.969

Set At 12,789' PBD effective 12,681' PERFS 11,641' - 11,900'

147' - 2 SPF - 308 shots

Tubing OD 4 1/2" C-75 WT 12.75# Type Hydril CS Make Youngstown

No. Joints on Location 452 Tally 13,720

No. Joints Run 375 Tally 11,392.48

PERMANENT STRING FROM BOTTOM UP

No. Joints	Description	Measured Length	KB Depth	Remarks
1	2 7/8" Mule Shoe Hydril CS	6.00	11,606	tubing open-ended
1	BFC 2 7/8" CS x 2.25"F"	0.80	11,599	
1	2 7/8" CS tubing	30.39	11,569	
1	BFC 2 7/8" CS x 2.25 "F"	0.80	11,568	
1	2 7/8" CS perforated pup	9.80	11,558	
1	BFC 2 7/8" CS x 2.31"F"	0.80	11,557	
1	2 7/8" CS pup	0.94	11,548	
1	BFC 2 7/8" CS x 2.31 "F"	0.80	11,547	
1	2 7/8" CS pup	7.15	11,539	
1	Baker "E" Anchor seal Assembly	3.15	11,536	
1	Baker ER1 tubing seal receptacle	42.00	11,494	Receptacle open 5' and is 37' long
	Total String Length			
	KB to Tubing Top	111.63		
	String Depth KB			

Remarks

Field Supervisor L.F. Kerkhoff

D&S PETROLEUM CONSULTANTS LTD.

73F3

TUBING SUMMARY

Well Columbia et al Kotaneelee Date

KB Elevation KB to CSG FLG KB to TBG TOP

Casing OD WT MIN DIA

Set At PBD PERFS

Tubing OD WT Type Make

No. Joints on Location Tally

No. Joints Run Tally

PERMANENT STRING FROM BOTTOM UP

No. Joints	Description	Measured Length	KB Depth	Remarks
1	3 1/2" CS x pup	5.94	11,488	
1	BFC 3 1/2" CS x 2.628 "R"	0.91	11,487	
1	3 1/2" CS tubing	32.45	11,455	
1	Baker "L" 3 1/2" CS sliding	sleeve 2.97	11,452	
1	3 1/2" CS tubing	29.65	11,422	
1	4 1/2" x 3 1/2" CS X over	.89	11,421	
1	Baker 4 1/2" CS x 3.688 "F"	1.00	11,420	
369	4 1/2" CS tubing	11,209.91	11,211	
	correction for tubing stretch	-9	220	
1	Baker 4 1/2" CS x 3.81 "F"	1.00	219	
5	4 1/2" CS tubing	152.52	66	
2	4 1/2" CS pups	11.78	54	

Total String Length 11,551.65

KB to Tubing Top

String Depth KB

Remarks Tubing was tested to 8000 psi with Gator-Hawk equipment, 4 1/2" Hydril joints were made up to 4500# torque. After tubing was landed and headed up annulus was tested to 5400 psi and tubing to 6400 psi.

Field Supervisor

D&S PETROLEUM CONSULTANTS LTD.

TUBING SUMMARY

73F 3

Well COLUMBIA ET AL KOTANEELEE YT H38 Date _____

KB Elevation _____ KB to CSG FLG _____ KB to TBG TOP _____

Casing OD _____ WT _____ MIN DIA _____

Set At _____ PBD _____ PERFS _____

Tubing OD _____ WT _____ Type _____ Make _____

No. Joints on Location _____ Tally _____

No. Joints Run _____ Tally _____

PERMANENT STRING FROM BOTTOM UP

No. Joints	Description	Measured Length	KB Depth	Remarks
1	4 1/2" CS double pin sub	3.54	51	
1	4 1/2" CS tubing	30.05	21	

Total String Length	11,585.24
KB to Tubing Top	21
String Depth KB	11,606

Remarks _____

Field Supervisor L.F. Kerkhoff

D&S PETROLEUM CONSULTANTS LTD.

TUBULAR TALLY

73F4

WELL: COLUMBIA ET AL KOTANEELEE YT H38 DATE: Oct 25/77 19__

Size: 4 1/2" Weight: 12.75 #/Ft. Thread: CS Hydril Grade: C-75 Make: Hydril

Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
1	31 08	21	29 85	41	29 69	61	31 44	81	29 00
2	30 74	22	31 38	42	30 44	62	30 68	82	28 84
3	30 94	23	30 30	43	30 68	63	30 64	83	30 81
4	30 63	24	30 76	44	30 65	64	30 07	84	30 78
5	30 57	25	28 08	45	30 42	65	29 75	85	28 55
6	29 96	26	30 52	46	31 48	66	30 36	86	30 41
7	29 44	27	30 80	47	30 18	67	30 74	87	30 68
8	30 48	28	30 60	48	30 88	68	29 56	88	29 80
9	30 63	29	29 65	49	29 90	69	29 76	89	30 23
10	29 86	30	30 85	50	30 03	70	30 09	90	30 69
TOTAL	304 33	TOTAL	302 79	TOTAL	304 35	TOTAL	303 09	TOTAL	299 79
Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
11	31 20	31	out* 30 79	51	30 38	71	30 93	91	31 17
12	30 97	32	30 89	52	28 55	72	30 22	92	30 82
13	30 93	33	30 88	53	30 05	73	30 54	93	29 22
14	30 62	34	31 10	54	30 60	74	out * 29 82	94	30 58
15	30 89	35	31 47	55	30 78	75	30 84	95	30 43
16	30 87	36	29 48	56	30 29	76	30 10	96	29 88
17	30 78	37	30 57	57	30 93	77	30 32	97	29 65
18	30 77	38	31 01	58	30 43	78	29 67	98	30 07
19	29 82	39	30 71	59	30 52	79	30 73	99	29 91
20	30 15	40	30 50	60	30 98	80	31 42	100	30 67
TOTAL	307 00	TOTAL	307 40	TOTAL	303 51	TOTAL	304 59	TOTAL	302 40

TALLY SUMMARY

GROUP NO.	LENGTH	JTS	LENGTH	
1-10	304 33			BROUGHT FORWARD
11-20	307 00	100	3039 25	PAGE TOTAL
21-30	302 79			TOTAL ON LOCATION
31-40	307 40			TOTAL LEFT OUT (incl. L.J.)
41-50	304 35			TOTAL PERMANENTLY IN HOLE
51-60	303 51			
61-70	303 09			
71-80	304 59			
81-90	299 79			
91-100	302 40			
TOTAL	3039 25			

* Left out

** Damaged

(Note transfer of left out joints to where and by whom.)

REMARKS: (Use separate page for each weight, grade or thread.)

Tallied by

D&S PETROLEUM CONSULTANTS LTD.

TUBULAR TALLY

73F 4

WELL: COLUMBIA ET AL KOTANEELEE YT H38 DATE: 19

Size: Weight: #/Ft. Thread: Grade: Make:

Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
101 out*	30 58	21	29 81	41	28 43	61	29 74	81	30 79
2	29 45	22	30 30	42	30 57	62	29 98	82	30 98
3	30 89	23	29 87	43	30 79	63	30 23	83	30 41
4	29 97	24	29 85	44	30 88	64	30 85	84	30 33
5	30 63	25	30 93	45	29 99	65	30 63	85	29 98
6	30 51	26	30 23	46	30 01	66	30 64	86	29 34
7	30 62	27	30 63	47	30 90	67	30 28	87	30 84
8	30 85	28	29 87	48	30 51	68	30 51	88	31 39
9	29 38	29	31 59	49	30 13	69	31 07	89	29 64
10	29 64	30	30 59	50	30 70	70	30 15	90	30 14
TOTAL	302 52	TOTAL	303 67	TOTAL	302 91	TOTAL	304 08	TOTAL	303 84
Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
11	28 84	31	30 60	51	30 22	71	30 29	91	29 78
12	30 87	32	29 96	52	30 80	72	30 60	92	30 82
13	30 67	33	30 53	53	30 29	73	29 75	93	31 14
14	30 29	34	30 62	54	30 99	74	29 71	94	30 51
15	30 68	35	27 82	55	30 68	75	29 90	95	29 78
16	30 18	36	30 55	56	28 97	76	31 40	96	30 13
17	29 49	37	30 63	57	30 60	77	30 40	97	30 62
18	30 76	38	30 94	58	31 05	78	30 58	98	30 73
19	30 99	39	30 43	59	30 24	79	30 80	99	27 87
20	30 63	40	30 96	60	30 48	80	31 00	200	30 10
TOTAL	303 40	TOTAL	303 04	TOTAL	304 32	TOTAL	304 43	TOTAL	301 48

TALLY SUMMARY

GROUP NO.	LENGTH	JTS	LENGTH	
1-10	302 52	100	3039	25
11-20	303 40	100	3033	69
21-30	303 67	200	6072	94
31-40	303 04			
41-50	302 91			
51-60	304 32			
61-70	304 08			
71-80	304 43			
81-90	303 84			
91-100	301 48			
TOTAL	3033 69			

BROUGHT FORWARD		
PAGE TOTAL		
TOTAL ON LOCATION		
TOTAL LEFT OUT (incl. L.J.)		
TOTAL PERMANENTLY IN HOLE		

* Left out

** Damaged

(Note transfer of left out joints to where and by whom.)

REMARKS: (Use separate page for each weight, grade or thread.)

Tallied by

D&S PETROLEUM CONSULTANTS LTD.

TUBULAR TALLY

73F4

WELL: COLUMBIA ET AL KOTANEELEE YT H38 DATE: 19

Size: Weight: #/Ft. Thread: Grade: Make:

Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
201	30 18	21	30 82	41 *	30 53	61	30 51	81	30 46
2	30 67	22	28 69	42	30 27	62	30 35	82	30 22
3	30 65	23*	29 11	43	30 34	63	30 64	83	30 61
4	30 50	24	30 72	44	30 68	64	30 70	84	30 47
5	29 22	25	30 29	45	30 12	65	30 90	85	30 78
6	30 97	26	30 14	46	30 17	66	29 70	86	29 19
7	30 07	27	30 54	47	30 29	67	28 15	87	30 67
8	30 08	28	29 77	48	30 38	68	30 22	88	31 71
9	31 10	29	27 20	49	30 85	69	29 69	89	30 50
10	30 15	30	27 62	50	28 34	70	30 74	90	30 15
TOTAL	303 59	TOTAL	294 90	TOTAL	301 97	TOTAL	301 60	TOTAL	304 76
Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
11	30 50	31	30 43	51	30 65	71	30 37	91	29 83
12	30 29	32	30 92	52	30 44	72	30 15	92	31 21
13	30 64	33	30 90	53	30 52	73	30 52	93	30 92
14	29 74	34	30 45	54	30 19	74	30 89	94	29 40
15	30 56	35	30 68	55	30 35	75	30 06	95	30 91
16	30 65	36	30 58	56	29 76	76	30 70	96	31 01
17	30 52	37	30 40	57	30 59	77	30 04	97	30 53
18	30 05	38	30 80	58	30 64	78*	30 03	98	30 73
19	30 22	39	30 62	59	31 53	79	30 78	99	30 94
20	30 72	40	30 35	60	31 39	80	30 55	100	30 60
TOTAL	303 89	TOTAL	306 13	TOTAL	306 06	TOTAL	304 09	TOTAL	306 08

TALLY SUMMARY

GROUP NO.	LENGTH	JTS	LENGTH	
1-10	303 59	200	6072 94	BROUGHT FORWARD
11-20	303 89	100	3033 07	PAGE TOTAL
21-30	294 90	300	9106 01	TOTAL ON LOCATION
31-40	306 13			TOTAL LEFT OUT (incl. L.J.)
41-50	301 97			TOTAL PERMANENTLY IN HOLE
51-60	306 06			
61-70	301 60			
71-80	304 09			
81-90	304 76			
91-100	306 08			
TOTAL	3033 07			

* Left out

** Damaged

(Note transfer of left out joints to where and by whom.)

REMARKS: (Use separate page for each weight, grade or thread.)

Tallied by

D&S PETROLEUM CONSULTANTS LTD.

TUBULAR TALLY

73F 4

WELL: COLUMBIA ET AL KOTANEELEE YT H38 DATE: 19

Size: Weight: #/Ft. Thread: Grade: Make:

Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
3 DP	30 69	21	29 99	41	30 90	61	30 44	81	30 18
2	27 88	22	31 16	42	30 67	62	30 71	82	30 80
3	30 83	23	31 63	43	30 91	63	30 80	83	29 90
4	28 42	24	30 89	44	29 79	64	30 49	84	30 81
5	30 80	25	30 68	45	30 27	65	30 65	85	30 05
6	30 30	26	30 44	46	30 93	66	30 31	86 *	30 40
7	30 07	27	31 10	47	30 72	67	30 38	87 *	29 96
8	30 62	28	31 27	48	30 80	68	30 77	88 *	30 48
9	30 93	29	26 45	49	30 55	69	31 18	89 *	29 84
10	30 35	30	31 30	50	29 90	70	29 30	90 *	31 50
TOTAL	300 89	TOTAL	304 93	TOTAL	305 44	TOTAL	305 03	TOTAL	303 92
Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH	Joint Number	LENGTH
11	29 73	31	29 04	51	30 80	71	30 21	91 *	30 03
12	30 86	32	30 11	52 *	30 01	72	30 49	92 *	30 91
13	28 50	33 *	30 51	53	29 05	73	30 39	93 *	30 90
14	30 77	34	30 71	54	30 12	74	30 50	94 *	30 57
15	30 93	35	30 44	55	30 90	75	30 62	95 *	30 59
16	30 67	36	30 86	56	30 67	76	31 19	96 *	29 62
17	30 61	37	30 77	57	30 04	77	29 78	97 *	30 92
18	30 17	38	31 45	58	31 16	78	31 19	98 *	30 13
19	30 30	39	27 55	59	28 10	79	29 84	99 *	30 42
20	30 57	40	30 79	60	30 52	80	30 83	100 *	30 57
TOTAL	303 11	TOTAL	302 23	TOTAL	301 37	TOTAL	305 04	TOTAL	304 66

TALLY SUMMARY

GROUP NO.	LENGTH	JTS	LENGTH	
1-10	300 89	300	9106 01	BROUGHT FORWARD
11-20	303 11	100	3036 62	PAGE TOTAL
21-30	304 93	400	12142 63	TOTAL ON LOCATION
31-40	302 23	25	750 15	TOTAL LEFT OUT (incl. L.J.)
41-50	305 44	375	11392 48	TOTAL PERMANENTLY IN HOLE
51-60	301 37			
61-70	305 03			
71-80	305 04			
81-90	303 92			
91-100	304 66			
TOTAL	3036 62			

* Left out

** Damaged

(Note transfer of left out joints to where and by whom.)

REMARKS: (Use separate page for each weight, grade or thread.) 8 jts damaged,

52 jts on lease. Collars egged.

2 pup joints, 7.78 and 6.64 left on lease

Tallied by

Perforation Record

All shot with Schlumberger Hyperdome Tubing gun.

Interval	No. Shots	Date
11,641'-11,665'	49	Oct. 29, 1977
11,668'-11,687'	39	"
11,700'-11,720'	41	"
11,729'-11,742'	27	"
11,763'-11,780'	35	"
11,789'-11,792'	7	"
11,795'-11,798'	7	"
11,803'-11,806'	7	"
11,809'-11,818'	19	"
11,824'-11,831'	15	"
11,847'-11,854'	15	"
11,857'-11,867'	21	"
11,871'-11,874'	7	"
11,890'-11,900'	21	"

COLUMBIA ET AL KOTANEELEE YT H38

November 29, 1977

Rigging up to do acid job. Delays due to weather, made one flight yesterday, started to rain, this morning fogged in and unable to fly.

Moved 10,000 gallons 28% HCl acid and two 400 barrel tanks from Beaver Barge landing to H-38 well site. Heating acid with steam to 100°F. Schlumberger wire line unit and 2 Halliburton units moved over from Beaver River.

Will start rig motor and raise derrick. Haul in Haliburton iron, and set up flare lines and tie-in to flare manifold. Fill 400 barrel tank with displacement fluid and heat to 100°F with steam.

Estimated timing for acid job Thursday, December 1.

November 30, 1977 (-25°F)

Rigging up to do acid job. Transferred acid to new 400 Barrel tank after 4" valve cracked. Lost approximately 4-5 barrels acid. Started rig motor and will raise derrick today.

Will pressure test all lines and flow well to pit and prepare to do acid job Thursday AM.

December 1, 1977

Preparing to do acid job. Acid and displacement fluid heated to 100°F. Haliburton preparing to pressure test lines. Schlumberger rigging up to run wireline if necessary.

KOTANEELEE YT H-38

Friday, December 2, 1977

8:00 A.M. - Flowing well to clean up
20/64 choke, 2900-3200 psig back pressure,
estimated rate 7-8 MMcf/d.

Heated acid to 102°F and cut 28% HCL to 15% with water, heated flush fluid to 112°F. Pressure tested Howco lines to 10,000 psig and Nowsco lines to 4000 psig (Nowsco used for back pressure on annulus). Set annulus relief valve at 4000 psig. Pumped 1000 gals. 15% HCL and additives, pump pressure 4500 increased to 6000 psig and broke back to 3000 psig. Displaced with 175 barrels water, pressure decreased from 3000 to 2500 by end of displacement. ISIP - 2500 psig and after 15 minutes 1000 psig. Rate held constant at 6 barrels throughout first stage.

Pumped 15,000 gallons 15% HCL with 450 gallons HAI-75, 90 gallons Pen-6, 25 gallons Howco suds, at 6 barrels per minute with 10 ball sealers per minute throughout. Displaced by 175 barrels water and diesel fuel. Injection pressures varied from 2500 - 3400 psig. ISIP 3000 psig, after 15 minutes 900 psig. Removed injection lines, frac head and opened well to flare pit. The following flow data was obtained:

DATE	TIME	TBG. PRESS	TEMP	CHOKE	REMARKS
Dec 1	8:20 PM	1625		20/64	Recovering diesel
	9:20	1600	80		
	10:00	1200	80		
	11:00	1600	80		
Dec 2	12:30 AM	1650	80		Choke plugged
	3:30	3500		8/64	diesel and acid
	4:00	3300	76	10/64	water
	5:00	2830	76	16/64	acid water
	6:00	2975		20/64	7-8 MMcf/d and acid water

KOTANEELEE YT H-38

Saturday December 3, 1977

Flowing well to flare pit on 40/64 choke. Approximate rate 20 MMcf per day along with some acid water. The flow data for the last 24 hours is as follows:

DATE	TIME	TBG PRESS	TEMP	CHOKE	REMARKS
Dec 2	10:00 AM	3225	83	20/64	7-8 MMcf plus
	11:00	3125	82	30/64	acid water
	12:00 noon	2750		40/64	
	1:30	2080	84	40/64	19 MMcf/d plus
	2:00	2060	122	40/64	acid water
	3:00	2033	126	40/64	
	4:00	2025	132	40/64	
	5:00	2023	134	40/64	
	6:00	2025	137	40/64	
	7:00	2028	138	40/64	
	8:00	2031	140	40/64	
	9:00	2035	142	40/64	
	10:00	2040	142	40/64	
	11:00	2045	142	40/64	
	12:00 mid.	2049	144	40/64	
Dec 3	1:00 AM	2053	144	40/64	20 MMcf/d plus
	2:00	2056	144	40/64	acid water
	3:00	2061	148	40/64	
	4:00	2066	148	40/64	
	5:00	2077	148	40/64	
	6:00	2075	148	40/64	
	7:00	2078	150	40/64	
	8:00	2082	150	40/64	

KOTANEELEE YT H-38

Sunday December 4, 1977

Flowing well to flare pit on 40/64 choke, approximate rate 20 MMcf/d along with some acid water. Well appears to be cleaning up. The rates for last 24 hours are as follows:

DATE	TIME	TBG PRESS	TEMP	CHOKE	REMARKS
Dec 3	9:00 AM	2085	154	40/64	20 MMcf/d plus
	10:00	2090	154	40/64	acid water
	11:00	2093	154	40/64	
	12:00 noon	1096	154	40/64	
	1:00	2100	156	40/64	
	2:00	2104	156	40/64	
	3:00	2106	156	40/64	
	4:00	2110	156	40/64	
	5:00	2114	157	40/64	
	6:00	2116	157	40/64	
	7:00	2118	158	40/64	
	8:00	2122	158	40/64	
	9:00	2124	158	40/64	
	10:00	2126	158	40/64	
	11:00	2129	158	40/64	
	12:00 mid	2131	158	40/64	20 MMcf/d plus
Dec 4	1:00 AM	2137	159	40/64	light fresh
	2:00	2137	158	40/64	water spray
	3:00	2139	160	40/64	
	4:00	2140	160	40/64	
	5:00	2142	160	40/64	
	6:00	2144	160	40/64	
	7:00	2147	162	40/64	
	8:00	2149	162	40/64	
	9:00	2152	162	40/64	

Well shut in to run Gradient, set BH Pressure recorders for AOF test

KOTANEELEE YT H38

Monday December 5, 1977

Ran in hole with Baker F-S plug to set in lower F nipple at 11599. Plug caught and stuck at 11505. Pulled out of hole with wireline and ran back in with overshot and retrieved plug. Ran in with second F-S plug and set in F nipple at 11599 as per program. Preparing to run gradient. Temperature -25°F overnight.

Tuesday December 6, 1977 (-45°F)

Waiting on bottom hole pressure recorders. Recorders coming on CP Air this afternoon. Ran in hole with BH pressure recorders, recorders hung up at 11505' and released. Recorders fell 94 feet to bottom plug at 11599'. Ran in hole with retrieval tool, (O.D. 1.67), no indicated restriction at 11505', retrieved recorders. Several joints on pressure recorders damaged.

Gradients and final AOF to be run, and will be forwarded as separate report.

APPENDIX

COLUMBIA GAS DEVELOPMENT CANADA LTD ET AL

PRESSURE REPORT

Columbia Gas et al Kotaneelee YT H-38

November, 1977

Submitted by R.D. Dook
E.F. Doyle

of Exploration Logging Canada Ltd.

INTRODUCTION TO PRESSURE THEORY

I TERMINOLOGY

Basic understanding of pressure terms is essential to any discussion of pressure theory. The following is a list of terms:

1. Hydrostatic Pressure

$$P = 0.052 \times W \times D$$

where P = hydrostatic pressure, psi
W = fluid density, ppg
D = vertical depth, ft.
0.052 = constant of proportionality

2. Equivalent Mud Weight

$$We = \frac{Pp}{0.052 \times D}$$

where We = equivalent mud weight, ppg
Pp = formation pressure, psi

In abnormally pressured formations

$$We = Wf + \frac{Pe}{0.052 \times D}$$

where Wf = formation fluid density, ppg
Pe = pressure in excess of normal hydrostatic pressure, psi

With increasing penetration into an overpressured zone (increasing D), the extra mud weight required will decrease. Hence, if the mud weight is increased to balance formation pressure upon entrance of the zone, it will overbalance the formation pressure at greater depths within the zone.

In the event of a kick, with the mud weight being increased, sufficient pressure uphole may fracture the formation at the casing seat, due to the equivalent mud weight increasing uphole.

3. Pressure Gradient

$$\text{Pressure Gradient} = \frac{P}{D} = 0.052 \times W$$

Normal pressure gradients are: 0.433 psi/ft. (fresh water)
0.468 psi/ft. (saline water)

4. Effective Circulating Density (E.C.D.)

E.C.D. is the total pressure effective at the bottom of the hole whilst circulating.

$$E.C.D. = Wo + \frac{\delta PA}{0.052 \times D}$$

I TERMINOLOGY CONT'D

where Wo - mud weight at surface (ppg)
δ PA = annular pressure loss (psi)

Annular pressure losses are determined using the Power Model for the behaviour of a drilling fluid.

5. Formation Pressure

$S = \sigma + Pp$

where S = overburden pressure, psi
σ = rock grain pressure, psi
Pp = pore fluid pressure, psi

Pore (formation) pressure is the pore fluid pressure within any rock. Normally, this pressure will be equivalent to the hydrostatic pressure at the depth in question. A knowledge of environmental conditions is important, in order to understand the normality of any sequence. The Kotaneelee well was assumed to have a normal 0.435 psi/ft pressure gradient.

6. Pressure Abnormalities

If fluids are unable to communicate and equalize pressures, due to some form of restriction or barrier, an extra pressure will build up. If this pressure is positive,then the formation is said to be "overpressured". If negative, then the formation is said to be subnormally pressured.

Overpressured formations may be produced in several different ways, e.g. pressuring of a reservoir, communication between reservoirs at different depths, reservoir geometry and subcompaction of claystones and shales.

7. Formation Fracture Pressure

The stress regime within a formation may be resolved into three perpendicular stress vectors, i.e. one vertical and two horizontal. Since overburden is usually the greatest of these three stresses, fractures are normally vertical. Cores taken in the Nahanni exemplified this.

The formation fracture pressure is the hydrostatic pressure which will open pre-existing fractures or initiate fracturing within the formation. Pressure integrity tests were held at the Kotaneelee well, although fracturing by the drilling fluid was very unlikely.

II FORMATION PRESSURE INDICATORS

No pressure analysis plot, only pressure data plots, were made for the Kotaneelee well. However, ideas and recommendations concerning pressure phenomena were given using information gathered from the data.

II FORMATION PRESSURE INDICATORS CONT'D

The following is an explanation of each parameter which was monitored at the wellsite and plotted on the data log.

1. Direct Pressure Measurement

Formation pressures can be calculated from test results, or during a kick. The former was applicable to the Kotaneelee well, where test results gave a pressure of 9.4 ppg EMW for the Nahanni dolomite.

2. Flowline Temperature

The geothermal gradient for any normally pressured area is constant. However, across abnormally pressured formations the geothermal gradient is abnormally high. Since water has a lower thermal conductivity than rock matrix materials, higher water content in pressured rocks will reduce the thermal conductivity.

Measuring flowline temperatures is a practical way of determining temperature gradients. Care has to be taken in accounting for surface and treatments, flow rates, lithology, etc. Characteristically, temperature variations in and surrounding a pressure zone change dramatically. This can be detected at the flowline by a decrease or negative trend shift in temperature at the transition zone, followed by a sharp increase in temperature once the pressure zone has been entered.

3. Rate of Penetration

Rate of penetration in a formation is controlled by several factors: force applied; rotary speed; tooth efficiency; differential pressure. With constant drilling conditions in an uniform lithology, rate of penetration would be controlled by formation compaction alone. Hence, there would be direct correlation of formation pressure to rate of penetration.

The drilling exponent or "d-exponent" is a formulation which tries to achieve a normalization of drilling factors so that the rate of penetration can be equated with formation compaction.

Jorden and Shirley modified Bingham's earlier work to give the following equation:

$$d = \frac{\log \frac{R}{60N}}{\log \frac{12W}{10^6 B}}$$

where d = drilling exponent
R = rate of penetration ft/hr.
N = rotary speed, rpm
W = weight on bit, lb.
B = bit diameter, ins.

d is lithology specific

II FORMATION PRESSURE INDICATOR CONT'D

Rehm and McClendon proposed a correction, taking into account the effects of mud weight.

$$dxc = d \times \frac{We}{ECD}$$

where dxc = corrected drilling exponent
We = normal pore pressure gradient - EMW (ppg)

DXC does not account for drilling hydraulics, tooth efficiency and matrix strength. Consequently, any major changes in these factors will be reflected in the dxc, e.g. tooth wear and change of bit type.

4. Shale Density

Shale density is dependant upon matrix and fluid densities and porosity. In a normally pressured area, density will increase with depth as compaction increases and porosity decreases. If abnormally pressured shales are encountered then compaction is decreased and porosity increased, resulting in a lower shale density. A normal trend is first established as densities vary from area to area. Deviations from this trend, in the form of negative gradients will indicate an increase in pressure.

5. Gas and Borehole Conditions

With a near balance condition, there will be a tendancy for the formation or fluids to enter the well. Kicks will occur if there are high permeabilities. If the permeability is low then large trip and connection gases will be seen, and if the fluid is unable to flow, the formation will tend to cave, e.g. sloughing shales.

Connection gases are a result of swabbing effects, and an indication that a near balance condition exists. Background gases are also a good indicator as to the nature of the balance. Gradual buildup of background gases, particularly in shales, suggests a near balance or slightly underbalanced condition exists. Also, communication fractures may give high background gas, whilst the general lithology itself is impermeable.

DATA COLLECTION AND INTERPRETATION

A pressure data log was prepared at the wellsite during drilling. The main intention of this log was to aid with wellsite engineering decisions, and try to relate the physical properties of the formations to drilling techniques.

The log was drawn on a 1:1500 scale (approximate), and was divided into five vertical columns.

- Engineering Data/Corrected Drilling Exponent (DXC)
- Flowline Temperature ($T^{o}C$)
- Gas/Mud Weight
- Engineering Data/Shale Density
- Lithology/Remarks

For the purpose of this report, the well has been divided into three sections, separated by casing seats.

SECTION I - 1000' - 3025'

This section was drilled quite slowly using both rock and button bits. Bit performance seemed satisfactory considering the very hard nature of the formations penetrated. Prior to drilling into the Mattson sandstone, tooth wear remained at three or four, whereas drilling through it produced tooth wears of six to eight. The complete section (1100'-3025') drilled at little more than three to four feet per hour.

The Dxc (Corrected Drilling Exponent) was of little value as a pressure indicator primarily due to the lack of shale present in this section. Even though it is possible to determine pressure trend lines from sandstones, a complete control of local geology and formation pressures must be known to obtain any valuable trend evaluation. Also, the use of button bits adds a great amount of error to actual Dxc values, whilst gradual tooth/button wear and the use of button bits makes the trend line concept meaningless. Dxc values ranged from 0.94-1.98 over this section.

A plot of flowline temperatures gave values ranging from 28-56.5^{o}C. No significant pressure indicative trend was established. However, recognition of a fall in temperature prior to water flows was made. This can be seen from the temperature plot at 1650' and at 2650'. These temperature trends are somewhat misleading since these water flows were steady over a lengthy period of time, thus allowing some cooling. Since numerous bit changes were made whilst drilling this section, this added to the trend shifting, although it was a

minor inevitable problem. Certain changes in the volume of the mud flow occasionally brought temperatures down by 0.5-1.0°C, which gave erroneous values. These minor changes did not detract from the good flowline temperature plot which was obtained.

During the drilling of this section there was quite a wide range of gas values, which were partly due to changes in mud weights. Background gas values range from 0-300 units, whilst connection gases and trip gases have values of 0-320 units, and 30-1200 units respectively. Mud weight values range between 9.0-10.4 ppg.

Between 1100' and 1200', there was an increase in background, connection and trip gases. The mud weight was increased from 9.1 to 9.6 ppg, due to this gas increase associated with a water flow. This increase in weight drastically reduced the background gas and with a further increase to 9.9 ppg at 1350', the water flow was held back. Both trip and connection gases were reduced. A further water flow occurred at 1600' which began to reduce the mud weight. This continued until 1850' where the weight was 9.5 ppg. At this point, an increase of 0.7 ppg held the flow back and a 10.2 ppg mud was used to complete this section. Background, connection and trip gases were at higher values (70, 180, 700 units respectively), with a 9.5 ppg mud weight, than with a 9.9-10.2 ppg weight. At 2550' there was a significant increase in gas, with an associated water flow. A 10.2 ppg mud weight was being used. It would appear this increase in gas was due to an increase in the silty nature of the sequence,where there was an increase in porosity compared with the Mattson sandstone. Maximum values for background, connection and trip gases over this interval (2550'-3025') were 75,320 and 1200 units respectively.

Due to the lack of "clean" shales over this section, few shale density measurements were made. Those values obtained gave a range from 2.5-2.68 gms/cc. This shale interval overlying the Mattson sandstone was showing the signs of a pressure transition zone, and as penetration into the Mattson sandstone was made, a water flow occurred.

Lithologies encountered over this section were quite varied. Overlying the Fantasque chert was a shale/limestone unit which became very silty towards the base. The chert also became silty towards its base passing into a siltstone/shale sequence, before penetration of the Mattson sandstone. The Mattson itself was quite massive with some interbedded shales, siltstones, dolomites and limestones. A 13 3/8" casing was set in a massive sandstone at 3025'.

SECTION II - 3025' - 10850'

Due to size, this section has been subdivided into three units, based upon lithology.

UNIT A - 3025'-5250'

This unit comprises of the lower Mattson which is predominantly sand-

stone with some siltstone/shale/carbonate interbeds. Bit runs were generally long (maximum 90 3/4 hours), although penetration rate averaged four feet per hour through this unit. Occasional bits were pulled "green", but for the most part, tooth wear ranged from three to eight. Bearing problems were rare, although the harder lithologies certainly destroyed the bits faster. A selection of button and hard rock bits were used, each with varying success. Certainly, this interval proved that bit life was of prime importance, since penetration rates were so low.

A pressure integrity test (PIT) was performed under the casing shoe (3035') in the Mattson sandstone. The fracture pressure was found to be 20.24 ppg EMW (Equivalent Mud Weight).

Dxc again proved virtually useless in determining pressure trends. A scattered plot similar to Section I evolved. This was unavoidable due to the large number of bit runs in this section. Dxc values ranged from 1.32 - 2.06. This sequence of highly varied lithologies make Dxc unreliable in pressure determinations, and also as an indicator of bit wear.

The flowline temperatures over this section show no real abnormalities. Trend stepping due to bit changes followed normal patterns. Also, with the large number of surveys run, temperatures showed no high gradients, as time was plentiful for cooling. Temperature gradients after the first few circulations also showed no marked increases (often indicative of pressure zones). Over this interval, temperature values ranged from 35.5 - 51.9^{o}C.

Upon drilling out the 13 3/8" casing shoe, the mud weight was gradually decreased to 9.2 ppg. With this weight, there was a slight water flow suggesting that the Lower Mattson also held a water zone of high pressure and low volume. The mud weight was held between 9.2 - 9.4 ppg throughout this section, with no more water flows. Gas readings were lower than the previous section. Background, Connection and Trip Gas ranges were 2-60 units, 0-70 units, and 5-75 units respectively.

Shale density values ranged from 2.57 - 2.7 gms/cc. No exact trend lines were established, although density values were certainly lower over the sections with more gas.

UNIT B - 5250' - 8750'

This interval is made up of Mississippian rocks, predominantly shales and carbonates, with some minor silts, marks and charts.

Bit runs were longer (max. 105 hours) than in previous sections, particularly in the upper half of this unit. Penetration rates averaged 7-8'/hr., with tooth wear and bearing life extremely varied (1-7 and 1-8 respectively). These properties seemed dependant upon differences between bits rather than formation effects. Button bits were used for the most part, with the occasional rock bit.

DATA COLLECTION AND INTERPRETATION CONT'D

Dxc began for the first time to keep a steady trend, even with regular "weight on bit" changes. Rotary speeds were kept fairly steady, averaging 55-60 rpm. Dxc values showed a range of 1.42 - 2.00. Even though good trend lines were established, which enhanced a better qualitative approach to pressure determinations, no real normal trend could be used. This hindered a quantitative application. However, correlation of the dxc with Connection and Background Gas variations was good in uniform lithologies. Dxc variations due to carbonate/shale gradations were largely ignored. Interesting and significant dxc trend lines were found from 7000' - 7750'. Over this interval there was a gradual decrease in dxc values from 1.73 - 1.69, which accounts for approximately 0.2 ppg EMW pressure increase. With associated Background and Connection Gas increases, with shale density decreases, this section is indicative of a pressure transition zone.

Flowline temperatures again showed no abnormalities, and followed normal gradients. Values ranged from 47.0 - 58.0^{o}C.

Mud weights were kept in 9.3 - 9.4 ppg range until 7830', where the weight was increased to 9.5 ppg, with a further increase to 9.8 ppg at 7890'. A rapid increase in gas from 7750' necessitated this increase. A slight flow was observed in this section. From 5250' - 7750', Background, Connection and Trip Gases were all relatively low (5-140 units, 0-60 units, 5-95 units respectively). However, there was a gradual increase in the gases from 7000' onwards.

With the mud weight increase to 9.8 ppg at 7890', there was an immediate reduction in gas. By 8100', Background Gas had fallen to 35 units, Connection Gas to 80 units, and Trip Gas to 135 units. From there to 8750', there was a steady increase in gas, with BG, CG and TG increasing to 90, 120 and 640 units respectively. Mud weights over this section remained fairly steady between 9.8 - 10.0 ppg.

Shale density values show a very slight normal compaction trend, with valves ranging from 2.58 - 2.74 gms/cc. Occasional reverse trends are noticed, with associated gas buildup (7000' - 7750' and 8350' - 8650').

Some sloughing of the shales with drag and fill occurred in thick sections (5750' - 6150'), but these were not of a serious nature.

An open-hole drill stem test (DST #1: 7725' - 7921') was performed over a good carbonate section.

UNIT C: 8750' - 10850'

This unit was drilled at an average drilling rate of 6 ft/hr. Bit selection corresponded with literology type, with rock bits used for the shale intervals, and button bits for the harder formations. Tooth (button) wear and bearing life were quite varied (2-8 in both cases).

DATA COLLECTION AND INTERPRETATION CONT'D

The Dxc plot shows a typical normal trend development, with values ranging from 1.6 - 2.22. Stepping in this trend can be seen at bit changes, particularly when changing bit types. Correlation of gas buildup in the shales with the Dxc plot again is good. This is particularly noticeable at 9900' and 10,200'.

As with previous units there are no abnormalities with the temperature plot. The typically constant steady buildup of temperature changes at three interesting points (9860', 10,270' and 10,760'). Here, a marked temperature decrease occurs immediately prior to entering a gas zone.

A 9.6 - 10.1 ppg mud weight was used over this unit. Relatively high gas readings were monitored throughout, being particularly high during the drilling of the chert/shale interval (top at 10,340'). Prior to the chert penetration, background gas readings ranged from 30-200 units. Penetration of the chert and subsequent shales gave readings in the range 350 - 1000 + units. No great significance was placed upon CG over this unit, as these were comparatively low to BG. Trip Gases were high throughout, ranging from 700 - 1000 + units.

Shale densities followed predicted compaction patterns, with marked lower values over gas intervals (e.g. 9910' and 10,240'). Density values ranged from 2.59 - 2.71 gms/cc.

9 5/8" casing was set at 10,850', prior to penetrating the Nahanni dolomite, the prime target.

SECTION III - 10,850' - 12,789' (TOTAL DEPTH)

Due to distinct lithological differences this section has been subdivided into two units.

UNIT A: 10,850' - 11,640'

This interval drilled at an average rate of 4-5 ft/hr., through shales with minor charts and limestones. Both tooth and button bits were used with maximum efficiency in most cases.

The Dxc plot became scattered, with bit change trend stepping. Values ranged from 1.6 - 2.12. A definite reverse normal trend was established suggesting a gradual pressure buildup towards the base of this unit.

For the first time, the temperature plot showed an increase in gradient at the start of the bit run. Actual values (46.8 - 62.5^{0}C range) are slightly lower than previous sections, due to shorter bit runs.

BG showed a range from 20 - 1000 + units over this interval. CG's were also higher (range 20 - 1000 + units). Generally, TG's were 1000 + units. These high gas values, increasing with depth, are partly associated with a pressure buildup in the shales, and partly with fractures. The mud weight was 9.5 ppg upon drilling out of the shoe. This was increased at 11,060' to 9.9 - 10.0 ppg, in anticipation of penetrating the Nahanni higher than expected.

DATA COLLECTION AND INTERPRETATION CONT'D

This increase in weight would suggest that fracturing was responsible for most of the gas liberated to the hole, since an increase in hydrostatic pressure should give a decrease in gas liberation, unless the formation pressure buildup was equal in value to the hydrostatic pressure increases.

Shale densities showed a trend change at 11,130'. Prior to this depth, the density values were following a normal compaction trend (value range 2.64 - 2.72 gms/cc). However, for the remaining unit interval, a reverse trend was established (value range 2.72 - 2.62 gms/cc.) This would signify the pressure buildup in the shales themselves.

A P.I.T. was performed below the shoe, where the formation was tested to 10.74 ppg EMW.

UNIT B: 11,640' - 12,789' (TOTAL DEPTH)

This unit was drilled at an average rate of 9 ft/hr. Both tooth wear and bearing condition were not as high as with previous runs, due to the shorter bit runs between cored intervals.

The Dxc plot showed a marked scattering over the interval 11,640' - 12,200' which can be attributed to the fractured and vuggy nature of the Nahanni. From 12,200' - 12,789' a normal trend is established as the Nahanni becomes more homogeneous. Dxc values over this unit range from 1.26 - 1.90.

The temperature plot shows similar characteristicsto the previous section, notably the gradient increases after bit changes. Actual values (42 - 66.6^{o}C) are slightly higher, this being attributed to the deeper section.

A mud weight of 9.9 - 10.1 ppg was used throughout the drilling of this unit. Gas values were exceptionally high; TG = 2000 + units
BG = 270 - 600 units
CG = 80 - 1000 units;
attributed to vuggy porosity and fracture communication.

Six intervals were cored in the Nahanni, with four DST's run. DST #2 and #5 were successful, results showing a 4 mmcfd production with a 9.4 ppg EMW formation pressure.

CONCLUSIONS AND RECOMMENDATIONS

Certainly, from a pressure standpoint, the well was drilled very successfully. Hole problems were minimal, particularly in the intermediate 12¼" hole, where thick sections of shale were encountered. Bit selection was approached in a calculated manner which failed on rare occasions, but generally was efficient. The use of tooth bit (eg. SEC M44N) in the moderately hard Mississippian shale sections was successful, mainly due to the increased penetration effect of the teeth. Although button bits generally have a longer life, button penetration was retarded due to the fear of increased hole deviation. With a revised idea of formation drillability in the area, it is hoped that bit selection will be at an optimum in the forthcoming delineation/development program.

The Corrected Drilling Exponent (Dxc) plot proved to be very limited as a quantitative tool. Essentially a shale plot, the value of dxc trends will only be seen in forthcoming wells, where a direct comparison can be made. However, the qualitative value in the well was great, clearly indicating shale zones of increased gas content. With further work on the dxc, trend establishment for the development area can be achieved, and be utilized in an optimization program for eliminating hole problems. To achieve this it is imperative for a close monitoring of drilling parameters.

The flowline temperature plot proved to be very accurate, although was of limited use in revealing hole properties. Water flows in the surface and intermediate sections were indicated and on rare occasions minor transition zones were seen. Problems in establishing trend lines were numerous. These were mainly due to surface and mixing effects and short bit runs. For these reasons, plots of suction pit temperatures and differential temperatures ($T^{o}c$ OUT - $T^{o}c$ IN) were not made. An important and accurate tool, the temperature plot could become very valuable in the area, if improvements are made to the surface mud system.

Gas concentrations are fundamental to basic pressure control. High pressure/low volume gas accumulation, with gas-filled fractures, proved in this well that drilling can be achieved while carrying high concentrations. Due to known lack of permeability in the surface and intermediate hole sections, closely balanced drilling could be accomplished. With a KCL mud system, solid removal is imperative. This loss of additional weight must be accounted for by a somewhat conservative approach to the use of weight material in attaining a closely balanced fluid system. Both the gas detection system and mud weight monitoring system functioned well during drilling. One reservation concerning the mud weight sensors, is that the KCL system can become very aerated, causing fluctuations in the mud weight readout.

Shale density measurements proved to be a useful qualitative tool. As with the dxc plot, no quantitative approach was utilized. It is thought that for a more precise determination of densities, a single solution method be used instead of the multi-solution kit that is presently employed.

CONCLUSIONS AND RECOMMENDATIONS CONT'D

The level of sophistication in the logging unit is virtually at a maximum for a standard system. To improve such a service, it would be necessary to utilize a pressure package. It is thought that a fully computerized logging system is not needed. With a pressure package, a closer monitoring of the drilling parameters could be effected. Also, a greater control of hydraulics could be found, aiding the drilling. It is felt that the additional package (including personnel) would follow a path toward optimization of the delineation/development program.

EQUIPMENT

I THE LOGGING UNIT

An Exploration Logging Unit, number 120, was on location at the Kotaneelee YT H-38 wellsite for the duration of drilling operations with sample logging commencing at a depth of 1000' on April 25, 1977 and continuing to 12,789', total depth, on October 14, 1977.

Unit 120 was situated in an excellent position in close proximity to the shale shakers and rig floor. Power, water and compressed air were provided from the rig supply and a telephone link to the rig floor, engineer's office and living quarters was installed. It is a standard unit containing the following equipment:

- Penetration Rate and Depth Recording System
- Combustible-Gas Detectors
- Cuttings-Gas Detectors
- Pump Stroke Counters
- Chromatograph for the Analysis of Gaseous Hydrocarbons
- Honeywell Multipoint Recorder
- Equipment for Oil and Gas Show Evaluation

In addition to this, the unit contains secondary equipment in the form of:

- Mud Monitoring System - Pit Volume Totalizer, Dual Mud Weight and Dual Mud Temperature Recorders
- Multisolution Shale Density Kit
- Autocalcimeter (for the latter part of the well)

The unit was manned by graduate geologists working on a two weeks on the rig and one week off schedule, with two men on the rig at one time, each working a twelve hour tour, taking ditch samples at ten feet intervals and preparing a lithology log on a 1:500 scale upon which the following was recorded:

- Bit Data
- Drill Rates, in feet per hour, plotted every five feet

I THE LOGGING UNIT CONT'D

- Lithology Percentages and Types
- Gas Readings Comprising:
  - Continuous Ditch Gas in Gas Units
  - Chromatographic Analysis in ppm
  - Cuttings Gas in Gas Units
- Lithology Descriptions
- Information regarding casing depths, electric logs, mud reports, hole deviation, oil shows, core and drill stem test intervals and calcimetry results

A Pressure Log was also prepared on a scale of 1 cm:100' or approximately 1:2500, with plots of:

- Corrected Drilling Exponent (Dxc)
- Flowline Temperature - ^{o}C
- Background, Connection and Trip Gases
- Mud Weight - pounds per gallon
- Shale Density - grams per cc
- Lithology

CUTTINGS SAMPLES

Samples were collected at ten feet intervals and divided as follows:

1. About 0.5 kg of unwashed sample was placed in a small cloth bag and every one or two weeks the accumulated cloth bags sent to the Canadian Geological Survey Institute of Sedimentary and Petroleum Geology, 33rd Street N.W. Calgary, Alberta.

2. 100 cc of unwashed sample was disintegrated with 500 cc of water in a blender to obtain a Cuttings Gas reading.

3. The rest of the sample was washed through an 8-mesh sieve, collected in a 170-mesh sieve, washed until clean and then dried, after which approximately 20 gm were placed in a plastic phial and kept at the wellsite. The remaining fraction was used for examination.

   a. under ultra-violet light to check for fluorescence caused by the presence of oil, as opposed to natural fluoresence of minerals, such as calcite.

I THE LOGGING UNIT CONT'D

b. under a binocular microscope, after which the sample was described according to its rock type, colour, hardness, grain size, grain shape, sorting, cementation, porosity, accessory minerals, show; using the standard Exploration Logging abbreviations.

In the event of the sample being calcareous and/or shaly, it could be used to obtain limestone and dolomite percentages and/or shale density values.

This examination procedure is also followed when a core is being described.

II POWER AND AIR SUPPLY FOR LOGGING UNIT

AC POWER

The main power requirement for the unit is 115 volt, 60 cycles per second, 30 amps provided via a two conductor neoprene cable from the rig generator. This is routed through the main circuit breaker assembly and master switch with one part going to the unregulated portion of a circuit breaker box to provide power for the unit compressor, agitator motor and a set of unregulated AC power outlets along the inside of the unit, and another part going to a regulated AC "shorting plug" and being fed to circuit breakers supplying power for the fluorescent lights and regulated AC power outlets in the unit and the DC power supply.

There is also a 220 volt power supply used to run the air conditioning, heater or auxiliary equipment such as core-processing apparatus.

DC POWER

This is provided by the conversion of part of the sometimes widely varying AC power into a very stable DC power of 5.8 volts used for the gas detectors and other instruments where a stable power supply is very necessary.

AIR

A 120 psi air system is used in the unit and this is provided by the rig air supply or by the unit compressor. To prevent any surges in air supply from damaging equipment, regulators are installed in the line and an air filter is used to remove water and oil from the air. Once through the filter, the air is distributed via a manifold to various air lines in the unit, bristol tank to pressure up the bristol system and fill the hose with water, mud filter press used to obtain filtrate and filter cake readings from a mud sample, a blow off hose in the back-room of the unit.

III

VACUUM SYSTEM

The Exploration Logging Vacuum System provides a means of drawing gas from the mud in the ditch and passing it through filament chambers in the gas detectors for measurements of the concentrations of the combustible gases in the mud. A continuous steady vacuum of four to five inches of mercury and a total sample gas flow of 30 to 40 standard cubic feet per hour is provided by a twin-cylinder vacuum pump with one cylinder operating for the ditch gas system and the other providing the vacuum for the cuttings gas detector.

The outside part of the system consists of a gas trap partially immersed in the ditch so that mud passes through it continually. In the gas trap is a ¼ horse-power, 115 volt explosion proof agitator motor which agitates the mud causing the release of any gas which may have been held in suspension. The gas trap has an efficiency of up to 70% depending on mud properties such as viscosity, the speed of agitation and the level of mud in the gas trap. From the gas trap a 1" inside diameter plastic gas line carries the ditch gas into a condensate bottle where any mud and water can settle out before the sample is passed through a smaller diameter gas line into the back of the logging unit.

Upon entering the unit, the sample passes first through a gas filter, or beach filter, which removes water, oil and dirt carried from the condensate bottle, and then through a vapor filter which removes vapors heavier than pentane, such as diesel which is often added to the drilling mud. From here it passes through a meter indicating total flow in the system and through a flow-restriction orifice which enables the flow to be distributed to the gas detectors via sample flow meters to the chromatograph and to other gas instruments which may be present such as the Hydrogen Sulphide detector.

In the event of a blockage due to mud and water accumulating in the gas line, a liquid alarm pressure switch detects the resultant increase in vacuum pressure, switches off the vacuum pump and activates the liquid alarm to prevent the intake of fluid into the detector system. Then a solenoid blow-out valve is used to remove the gas line from the vacuum system and introduces 120 psi air into the gas line to clear it of the accumulated fluid. This is also used to clear out any mud and water which may have settled in the condensate bottle during normal operations.

IV PENETRATION RATE RECORDING SYSTEM

This uses the principle of hydrostatic pressure to indicate differences in the position of the kelly during drilling operations.

Basically the "Bristol" System consists of a rubber hose-pipe with one end connected to a water bottle chained to the kelly swivel and the other end connected via polyflo tubing to a pressure bellows inside the logging unit with a lever system which enables pressure differences in the bellows to be recorded on a chart. The recorder chart is circular, rotated by a clock-driven mechanism and consists of either eight or twenty-four one-hour radial divisions with one minute intervals and 60 concentric divisions representing one foot intervals.

The system is full of water all the time and as the kelly is raised or lowered the hydrostatic head of water between the bottle on the swivel and the datum (the logging unit) increases or decreases accordingly and the pressure difference is transmitted through the bellows and lever system to cause the movement of a pen o the circular chart. During drilling, as the kelly is lowered, the continual decrease in hydrostatic head causes pen movement towards the middle of the chart which, together with the rotation of the chart, produces a curve which indicates the amount of time taken to drill each foot, with increasing rate of penetration showing on the chart as increasing gradient of the curve.

It is necessary to know the length of each single drill pipe as it is added to the drill string so that each kelly down depth is known and consequently, during the drilling of each single to kelly down, the depth at any moment can be interpolated.

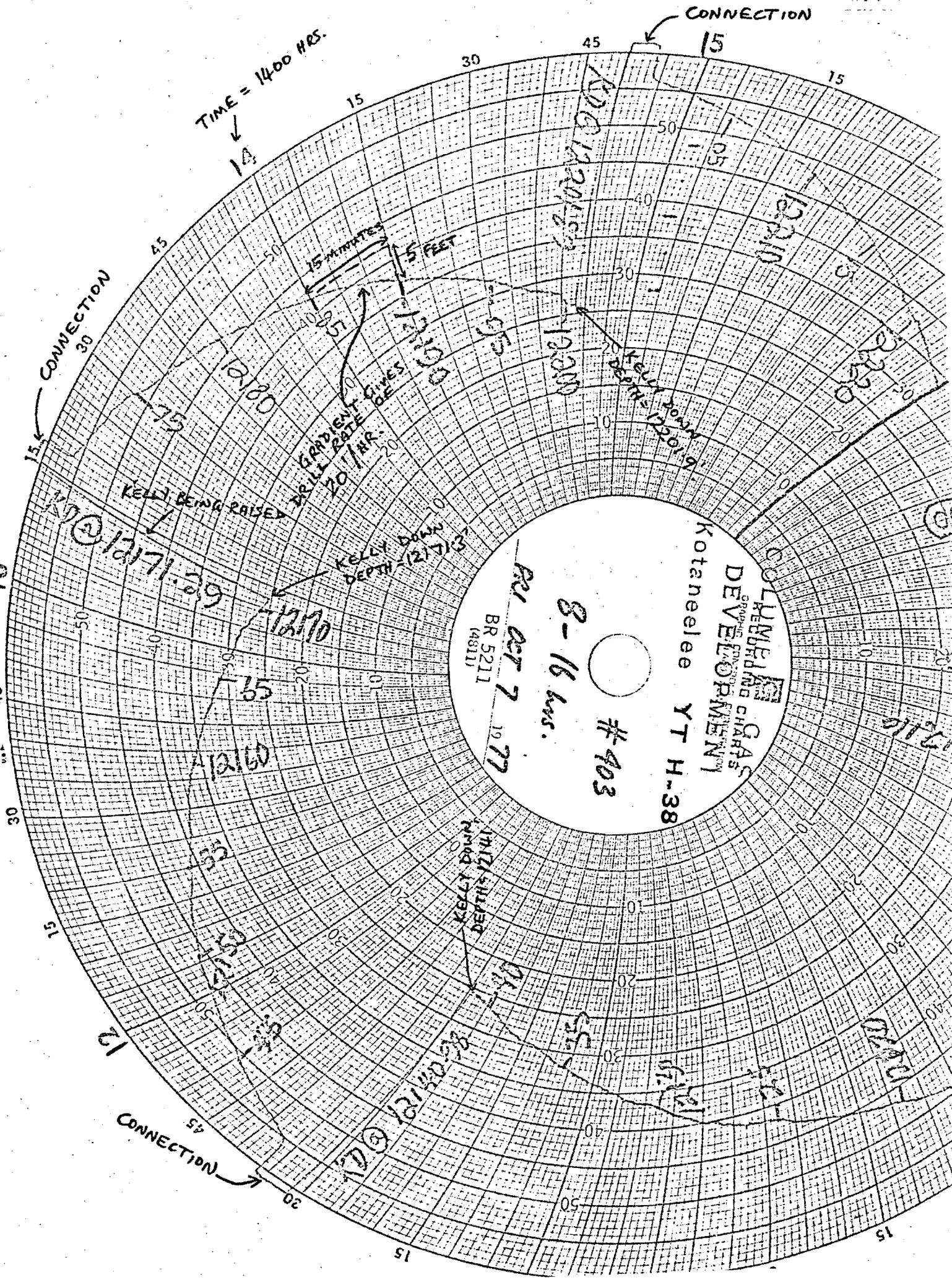
Advantages

1. It is a reliable, easy-to-maintain system.
2. Once it is calibrated and the span of the pen movement on the chart adjusted correctly, it should not normally need to be recalibrated.
3. The clockwork chart drive means that it is not affected by a loss of power to the logging unit or by variations in the frequency of rig power.

Disadvantages

1. In cold weather operation such as the Yukon winter, antifreeze must be added to the water in the system and because the density of antifreeze is not the same as the density of water, the pen mechanism must be recalibrated.
2. Hoses are subjected to alot of wear and tear while attached to the kelly hose and swivel and occasionally break or are worn through and leak, causing loss in hydrostatic pressure within the system and hence anomalous chart readings, although it is a matter of only a few minutes to repair the hose.
3. Care must be taken not to allow air bubbles to enter the system as these will upset the calibration due to subnormal hydrostatic head.

EXAMPLE CHART FROM PENETRATION RATE RECORDER.



V

HOT WIRE GAS DETECTOR

This has been used for many years in the petroleum industry and has proven itself to be simple, very reliable, easy to use and maintain, and easy to calibrate. It uses a Wheatstone Bridge circuit to detect and register changes in the resistivity of a platinum-coated filament, as it is heated by the combustion of gas, compared to the resistivity of a reference filament which is igniting just air. The hot wire detector is divided into two identical parts, one using a detector voltage of 2.2 volts for measuring the amount of all combustible gases in the sample mixture (the total gas detector), and the other using a voltage of 1.1 volts to detect all combustible gases except methane (the petroleum vapour detector). The filaments are calibrated to record 50 units of total gas (1 exploration logging gas unit = 200 ppm total gas) when a mixture of 1% methane in air is passed into the filament chamber.

The disadvantage of the hot-wire detector is that it only has a linear response to gas concentrations if all the gas is burning uniformly in the chamber. There is a critical concentration of gas above which explosive combustion will occur in the filament chambers and any of the following percentages of gases in the sample mixture will cause this.

Methane	7%
Ethane	4%
Propane	2.7%
Butane	2.3%
Pentane	1.8%

If the concentrations increase above this figure, pulsating explosions will result until sufficient oxygen is used up to cause complete cessation of combustion in the filament chambers. At the following concentrations the filament is inert and will not register any further increase in concentrations.

Methane	56%
Ethane	32%
Propane	22%
Butane	18%
Pentane	14%

As the gas concentration increases it is necessary to dilute the

V HOT WIRE GAS DETECTOR CONT'D

mixture being drawn into the filament chamber by introducing air into it. As long as the total flow into the chamber remains at two standard cubic feet per hour (scfh) it is possible to dilute the mixture up to one-twentieth of its initial concentration, i.e. 1.9 scfh of air with 0:1 scfh of gas sample before it becomes impossible to retain any vestige of accuracy in the results. Even at 1/20 attenuation the accuracy is poor and it is therefore essential to maintain the minimum attenuation possible at all times.

ATTENUA. FACTOR	SAMPLE FLOW (scfh)	AIR FLOW (scfh)	TOTAL FLOW (scfh)	GAS PERCENTAGE	GAS UNITS
x1	2	0	2	0- 2%	0- 100
x2	1	1	2	2- 4%	100- 200
x4	0.5	1.5	2	4- 8%	200- 400
x8	0.25	1.75	2	8-16%	400- 800
x20	0.1	1.9	2	16-40%	800-2000

The gas readings are indicated both on meters scaled from 0 to 100 units and also on the Honeywell Recorder as a 0 to 100 scale print out with total gas readings printed as a continuous red line and petroleum vapour readings as a continuous black line.

VI CHROMATOGRAPH

The chromatograph provides a method of determining the concentrations of gaseous hydrocarbons within the gas sample taken from the ditch. A sample of the gas is drawn into a column containing an inert material which effects a separation of the various hydrocarbons due to their differences in solubility, enabling methane, the least soluble, to separate out first followed by the others in order of their molecular weights and increasing solubilities, i.e. ethane, propane, butane, pentane and the heavier hydrocarbons. Each gas in turn then passes into a filament chamber where combustion occurs causing a change in the resistivity of the platinum-coated filament. As with the hot-wire detector, the Wheatstone Bridge circuit detects this change and it is registered as a series of peaks on a chart recorder with each peak representing a hydro-carbon concentration.

The column is divided into two sections and after butane has passed through the separation section, a back flush pressure is applied to this part of the column to expel the hydrocarbons heavier than butane, which take longer to pass through the separating column, so that sampling can proceed at regular intervals. The sampling cycle for the hydrocarbons from methane to butane takes five minutes after which time another sample of ditch gas is drawn into the separating column and the process continues. However, it is possible to prevent the back flush pressure being applied and therefore obtain a reading for pentane, hexane, etc. although, as the pentane peak appears on the chart about four or five minutes after butane, and the heavier gases a proportionately longer time after pentane, for practical purposes during drilling the cycle time of five minutes for results of methane, ethane, propane and butane concentrations is usually sufficient.

Again it is possible to attenuate the readings in the event of high hydrocarbon concentrations, although in this instrument attenuation is by electrical means, reducing the strength of the signal going to the chart recorder. Because the gas going into the filament chamber cannot be diluted with air it is necessary to recalibrate the filaments every few days, or more frequently in the event of high gas concentrations, due to a decrease in the sensitivity of the filaments. Calibration is done using a methane, ethane, propane, butane, pentane, air mixture of known concentrations and will give a value in parts per million of each hydrocarbon per division of the recorder chart. This value when multiplied by the attenuation value and the number of chart divisions of a peak gives the total parts per million concentration for that particular gas.

Saturation of the filament occurs when methane concentration exceeds approximately 100,000-110,000 ppm (10-11% methane) depending on filament sensitivity and again the minimum possible diluation factor must be used, as accuracy of results decreases with increasing diluation.

VII

CUTTINGS GAS DETECTOR

The "microgas" system is a duplicate of the hot-wire gas detector, being able to determine concentrations of total gas and petroleum vapours in the gas released when 100 milliliter of unwashed ditch cuttings sample are disintegrated in 500 milliliter of water in a blender. After disintegration, the gas produced is drawn into the filament chambers and the total gas/petroleum vapours values read off on a 0 to 100 units meter. Attenuation is by the same method as the main ditch gas detector, using varying ratios of sample gas and air according to concentrations of gas in the sample.

Uses

1. It gives some indication of reservoir characteristics such as porosity and permeability and the proximity of the gas-oil contact depending on the amount of gas released compared to the oil show in the cuttings sample.
2. It can be used to check the efficiency of the mud degassing system by using drilling mud instead of cuttings in the blender and measuring the amount of gas in the mud both before and after the mud has been through the degasser.

For good standardization of results, of course, it is necessary to use the same amounts of cuttings and water each time and to ensure that the cuttings are not left exposed to the air for too long after being collected from the shale shaker. Occasional replacement of the cutter blades in the blender is required, the frequency depending on the abrasiveness of the rock sample, in order to achieve uniform disintegration over a fixed time period, usually twenty seconds.

VIII

CALCIMETRY

Calcimetry is the determination of the types and percentages of carbonate minerals in a rock. The method normally used is based on a measurement of the amount of Carbon Dioxide released during the reaction of hydrochloric acid on a calcareous rock sample of known weight.

The Exploration Logging Autocalcimeter consists of an airtight pressure cell connected by polyflo tubing to a pressure transducer. The cell has two compartments, the larger of which contains a known weight, say 1 gram, of the crushed carbonate rock being analyzed,and the smaller one containing 0.ZN hydrochloric acid. The cell is sealed and tilted slightly to allow the acid to come in contact with the sample and carbon dioxide (CO_2) is immediately given off in direct proportion to the percentage of carbonate mineral in the sample. When calcite is the only carbonate mineral present, the following equation applies:

$$CaCO_3 + 2HCl = CaCl_2 + H_2O + CO_2$$

The ideal gas law equation is:

$$PV = nRT$$

P = Pressure
V = Volume
n = number of moles of gas
R = Gas content
T = Temperature (measured in degrees Kelvin: $0^oC = 273^oK$)

The reaction is exothermic, i.e. heat is produced during the reaction and the maximum increase in temperature due to the total reaction of 1 gram of 100% calcite is 4.59^oC in 10 milliliter of solution. Because the total system must be considered, i.e. gas phase and pressure cell, the temperature increase is only approximately 0.3^oC, which would result in an error small enough to be neglected. Therefore, the temperature is considered to be constant during the reaction within the system. Rearranging the above equation gives us: $P = \frac{nRT}{V}$ and since we are dealing with a closed system, $\frac{RT}{V}$ is constant K.

Therefore, $P \propto nK$, i.e. the pressure produced during the reaction is directly proportional to the number of gram molecules (moles) of gas. Hence it is directly proportional to the number of moles of carbonate and also therefore to the weight of carbonate present.

If there is any variation in the laboratory ambient temperature it must be corrected by using the following equation:

$$\frac{OP}{RT} = \frac{CP}{CT}$$

where OP = observed percentage of carbonate
CP = correct percentage of carbonate
RT = laboratory ambient temperature during reaction (^oK)
CT = laboratory ambient temperature during calibration (^oK)

VIII CALCIMETRY CONT'D

As the reaction proceeds and CO_2 is continually given off the pressure in the system increases and this pressure difference is measured by the transducer and relayed to a chart recorder. The information is recorded as a curve on a percentage scale and the relative percentages of each carbonate mineral are plotted on the lithology log in the cuttings gas column by the logging geologist.

The time taken for the reaction to reach completion is determined by the type of carbonate mineral present. Calcite, $CaCO_3$, releases CO_2 immediately and its fast reaction time will be shown on the percentage-time chart as an initial kick to the right which will indicate the amount of $CaCO_3$ present in the sample. Dolomite, $CaMg(CO_3)_2$, and Siderite, $FeCO_3$, have similar reaction speeds and the reaction is usually complete after five to ten minutes. Magnesite, $MgCO_3$, has a slower reaction speed than dolomite. See enclosed chart examples (overleaf).

Uses of Calcimetry

1. For the correlation of carbonate layers in stratigraphic studies.
2. In studies of environmental conditions during deposition.
3. For the identification of calcareous shales which may be associated with overpressured formations.

Advantages

1. It is a quick, simple and fairly accurate method of determining carbonate percentages.
2. The apparatus is relatively simple, reliable and easy to maintain.
3. It allows for the instant recognition of several types of carbonate.
4. Calibration is easy using 100% $CaCO_3$ and only needs to be done very occasionally.

Disadvantages

1. Readings are affected by even a slight change in laboratory ambient temperature and therefore constant monitoring of temperature is necessary.
2. It is important that only clean calcareous rock samples for the relevant depth are used and care must therefore be taken to ensure that cavings are not included if drill cuttings are used. Samples from a core will provide the most reliable readings.
3. Weighing of the crushed sample must be accurate.

Of course these drawbacks will apply to any scientific test so this method is really quite reliable, if it is used under controlled conditions.

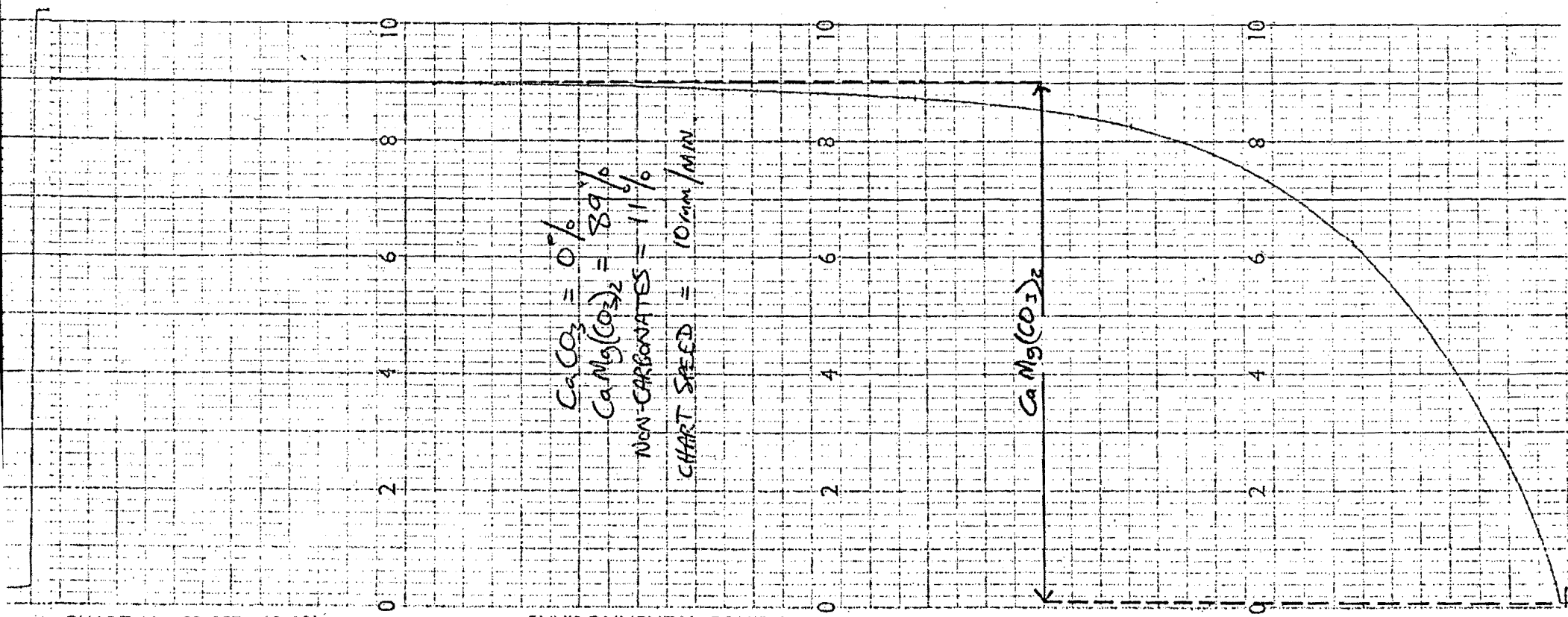
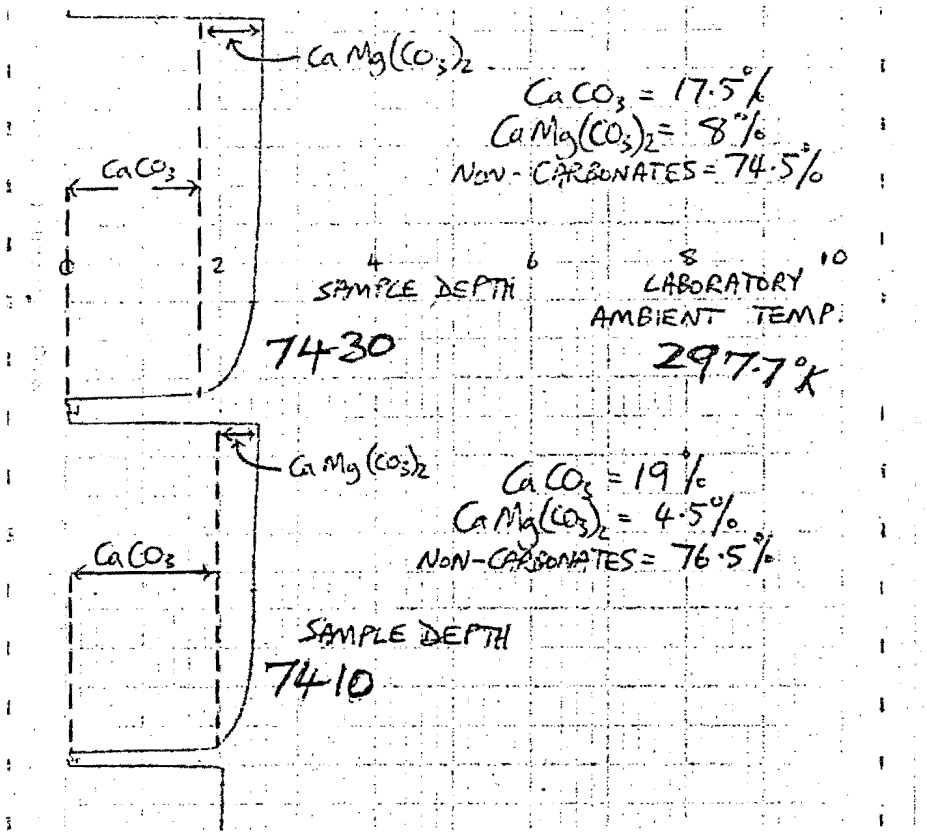
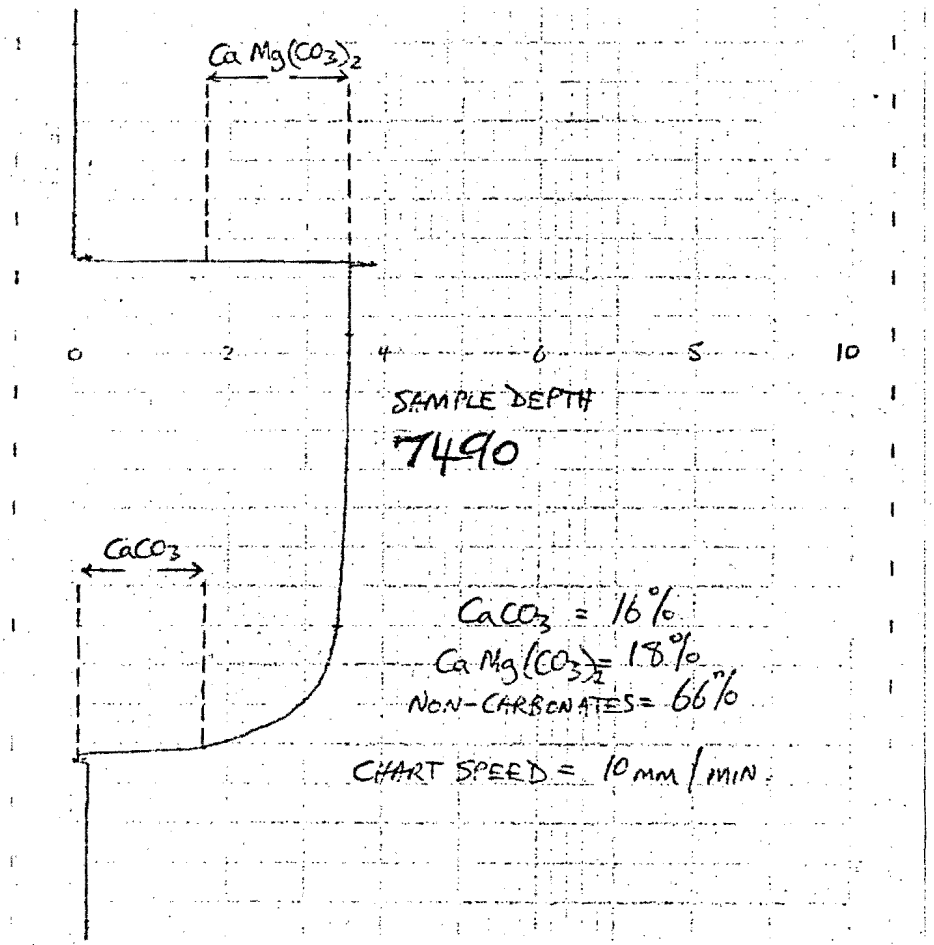


CHART No. SP-257 (0-10) ENVIRONMENTAL EQUIPMENTS LTD. 11/72


$CaMg(CO_3)_2$
$CaCO_3$
0
2
4
6
8
10
SAMPLE DEPTH
7430
LABORATORY AMBIENT TEMP.
297.7°K
$CaCO_3$ = 17.5%
$CaMg(CO_3)_2$ = 8%
NON-CARBONATES = 74.5%
$CaMg(CO_3)_2$
$CaCO_3$
SAMPLE DEPTH
7410
$CaCO_3$ = 19%
$CaMg(CO_3)_2$ = 4.5%
NON-CARBONATES = 76.5%


$CaMg(CO_3)_2$
0
2
4
6
8
10
SAMPLE DEPTH
7490
$CaCO_3$
$CaCO_3$ = 16%
$CaMg(CO_3)_2$ = 18%
NON-CARBONATES = 66%
CHART SPEED = 10 mm / min.

IX

MUD MONITORING SYSTEM

This is present in Unit 120 as secondary equipment in the form of Pit Volume Totalizer, Mud Weight and Mud Temperature measurements in and out of the hole.

1. Pit Volume Totalizer (PVT)

The basic pit level measurement is achieved using a float whose movement due to fluctuations in pit level provides a signal, via a potentiometer, the strength of which is directly proportional to the pit level. This signal is relayed to the Honeywell Recorder where the variations in float position, and hence pit level, are recorded as a blue line.

In Unit 120 a pit volume monitoring system is used in which the mud levels in a number of pits are monitored using a float pickup unit in each pit and the signal from each pickup combined in the PVT to provide a digital readout and an input signal for the multipoint recorder. The PVT has an alarm which can be set to sound immediately if any change in total pit volume of greater than ± 1 barrel should occur.

2. Mud Weight

This is measured using a heavy steel ball which is totally immersed in the mud. As the mud density changes there will be a slight apparent change in the weight of the ball due to a change in the buoyancy factor. The ball is attached by steel cable to a transducer which translates any slight movement caused by an apparent alteration in the weight of the ball into an electrical signal transmitted to the logging unit. This signal is then represented both as a digital display of mud weight and as a printout on the Honeywell Recorder.

By placing a ball and transducer unit in the suction pit and another in the ditch, away from the effects of turbulence, a constant check of mud weight entering and leaving the borehole can be made, thus ensuring that a balanced mud circulation condition can be maintained during drilling.

3. Mud Temperature

Again this is measured by pickup units in both the suction pit and the ditch. A temperature probe is immersed in the mud and as the temperature varies, a signal is produced, via a transducer, which is relayed to the logging unit and the temperature of mud entering and leaving the borehole is thereby displayed both on a digital readout and on the Honeywell Recorder.

As a particular depth interval is drilled the mud temperature entering the hole is noted and when the samples representing that interval appear at the surface the flowline temperature is noted. A plot is made on the Exploration Logging Pressure Log of the flowline temperature and/or differential temperature, (flowline temperature minus suction tank temperature) in degrees Centigrade, in order to detect changes in geothermal gradient which may indicate an overpressured formation.

MUD MONITORING SYSTEM CONT'D

As there are many variables which may affect flowline temperature readings, such as lagtime, pump rate, lithology, length of flowline exposed to cooling conditions (especially relevant offshore where the marine riser must be taken into account) and any chemical treatment of the mud on the surface, this cannot be used on its own as a method for the prediction of overpressures. It can, however, be of some use when used in conjunction with other overpressure evaluation techniques such as d-exponent, shale density, shale factor and gas and borehole conditions.

X

HONEYWELL MULTIPOINT RECORDER

The Honeywell Recorder is, in essence, a recording voltmeter and is used in the logging unit to record, via a printout on a strip chart, the measurements made by the gas detectors, pump stroke counters and secondary equipment such as pit volume totalizer, mud weight and mud temperature gauges. Each printout is colour-coded so it is possible to identify a certain reading immediately according to its colour.

Total Gas = Red
Petrol Vapours = Black
Pump Strokes = Green
Pit Volume = Blue
Mud Weight In/Out = Brown
Mud Temperature In/Out = Purple

When a signal is received from a detector it is amplified until it is large enough to turn a balance motor which drives a large aluminum gear and cable to reposition a printing carriage until it indicates the correct value. Since there are a number of voltages to be recorded, a rotary switch commutates the various input signals in a set sequence and the corresponding coloured point is printed on the chart.

The chart is driven at a constant speed of six centimeters per hour and has a scale from -10 to 0 to +100 in 1-unit divisions. The recorder is calibrated for each detector separately, for example when the gas detector is showing a reading of 50 units Total Gas the recorder is calibrated to printout a red line at the +50 mark on the chart. If the total pit volume is 420 barrels the recorder can be calibrated to print a blue line at the +60 mark and this reading is multiplied by seven to obtain the correct pit volume measurement.

The Recorder is very reliable, needs little routine maintenance and it is possible for the logging geologist to repair most malfunctions which may occur. As such it is an integral part of the logging unit and is in operation continuously to allow for constant monitoring during drilling operations and also to provide a record of the pit volume during trips.

CONCLUSIONS AND RECOMMENDATIONS

For the six months during which it was in operation the equipment gave very little trouble, and the problems which did arise were from two main sources.

1. Cold weather, which caused the water supply line to freeze up. This problem should however be alleviated during drilling of the next well by the use of the Exploration Logging cold weather system consisting of electrical heat tape and a long "sock" in which lines susceptible to freezing up, such as air, water and ditch gas hoses, can be run and surrounded by hot air blown through by a fan inside the unit.

2. Oil in the mud. In the midsection of the well from about 5000' to 10,800' approximately 3.5-4% oil was present in the mud and some oil vapour passed through the ditch gas hose and condensed inside the unit in the vacuum system. This necessitated repeated dismantling of the vacuum pump, filters and polyflo lines in order to clean out the oil accumulation which was causing malfunctions in the gas detection system. The addition of a second condensate bottle in the outside gas line may help overcome this problem on the next well.

To help the operator maximize the potential for early detection of a kick or a loss of mud from the system the use of the following pieces of equipment in the unit is recommended.

1. Ditch Flow Comparator - This enables a direct comparison to be made of the volume of mud entering the hole, in gallons per minute, and the volume returning over the shakers so that any discrepancy between the two figures is registered immediately as an alarm in the unit. The ditch-flow pickup consists of a paddle inserted in the flowline, which allows measurement of mud flow, relayed to a digital readout on the main panel inside the unit.

2. Extra Delaval Pit Level Sensors - In the event that the mud tank configuration is not modified before the next well, two more pit level sensors would greatly enhance the mud volume measuring capability because some of the tanks are divided into sections which make equalization of the mud level in any of these tanks hard to maintain and hence accurate monitoring of total mud volume with only one sensor in each tank is sometimes difficult.

With the occurrence of hydrogen sulphide gas in this well, it may be advisable to install a H_2S detector in the unit for future wells. The Exploration Logging detectors are of two main types.

1. Tubes containing lead acetate grains through which a continuous stream of ditch gas is passed and which, in the presence of H_2S, change colour

from white through gray to black depending on the concentrations of the gas.

2. An electronic detector which gives an analog readout of the concentration of H_2S present in the ditch gas in parts per million.

A single solution shale density column, if kept calibrated, will enable more accurate measurement to be made of shale density than the present multiple solution kit.

Promising results were obtained from calcimetry measurements made on samples from this well, expecially from the cores, and as the Exploration Logging autocalcimeter allows for good standarization of results, it is hoped that its use on future wells will make for more reliable correlation.