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NUMBER 706

OEL 20 AND OEL 21

EROMANGA BASIN AND WARBURTON BASIN

KALLADEINA 1

TEST REPORTS

Submitted by

Delhi Australian Petroleum Ltd and South Australian Oil and Gas Corp. Pty Ltd
1983

MINES and ENERGY RESOURCES SOUTH AUSTRALIA

Enquiries: Customer Services
Mines and Energy Resources South Australia
191 Greenhill Road, Parkside 5063
Library Telephone: (08) 8274 7522
General Enquiries Telephone: (08) 8274 7500
Facsimile: 08 8272 7597

ENVELOPE 706

TENEMENT: OELs 20 and 21; Eromanga and Warburton Basins

TENEMENT HOLDER: Delhi Australian Petroleum Ltd (operator) and Santos Ltd

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January 27, 1967.

The Director
Bureau of Mineral Resources
(Petroleum Exploration Branch)
P.O. Box 378
CANBERRA CITY A.C.T.

Dear Sir,

Delhi Australian Petroleum Ltd. and Santos Limited hereby apply for grant of subsidy under the provisions of the Petroleum Search Subsidy Act, 1959-1964, for a stratigraphic drilling operation. This operation will be designated as the Delhi-Santos Kalladeina No. 1 well, and has a proposed depth of 12,000 feet.

In accordance with the requirements set out in "Memorandum of Administrative Procedures" (Revised May, 1965), we have prepared and present herewith for your consideration the following data:

1. The applicants' name as Operator for Santos Limited and Delhi Australian Petroleum Ltd. is:

   Delhi Australian Petroleum Ltd.

2. The applicant's registered address is:

   18 Leigh Street
   ADELAIDE South Australia

3. Method selected for subsidy calculation:

Cost basis

4. All communications with respect to this application should be addressed to the Operator as follows:

Charles T. Easley
Resident Manager
Delhi Australian Petroleum Ltd.
G.P.O. Box 1837P
ADELAIDE South Australia

5. The sum of not less than $450,000 is available for the proposed operation. A detailed cost estimate is submitted herewith as Attachment No. 2.

6. Evidence in the form of a Power of Attorney, which is still in effect, showing that Charles T. Easley has full authority to act on behalf of the Company in all matters relating to Commonwealth subsidy has previously been lodged with The Director, Bureau of Mineral Resources, Canberra.

7. Delhi Australian Petroleum Ltd. is a publicly owned corporation, incorporated in the State of Delaware, U.S.A.

8. A detailed summary of the provisions of Oil Exploration Licences 20 and 21, State of South Australia, within the bounds of which the proposed test well will be located, has previously been lodged with The Director, Bureau of Mineral Resources, Canberra.

9. The location of the proposed Delhi-Santos Kalladeina No. 1 well is (approximately):

Latitude	27° 39' 24" S
Longitude	139° 23' 51" E
Elevation	108' ground level
	124' kelly bushing

The location is at seismic Shotpoint 101, seismic line "NA", established during 1966 by United Geophysical Corporation as part of the Eromanga-Frome Seismic & Gravity Survey. The location is shown on various exhibits accompanying this application. A precise survey of the location will be made after the drilling rig is in position.

10. Details of the National 80B drilling rig and associated equipment are set out in the "Programme of Rotary Drilling Operations" submitted herewith as Attachment No. 1. This is the same rig and equipment as has been used since early 1962 on the majority of Delhi-Santos exploratory wells.

11. Copies of the drilling contract with Drilling Contractors (Australia) Pty. Limited and the special services contracts with Schlumberger and Halliburton have previously been furnished to the Department and will apply to the proposed operation.

12. A sample of the daily drilling report form to be used has previously been submitted.

13. The following statements and discussions in support of this application are attached:

Attachment No.	1	Programme of Drilling Operations
	2	Cost Estimate and Associated Equipment Schedules
	3	Geology
	4	Geophysics
	5	Reasons for Drilling
	6	Target Depth
	7	Principal References

14. The following exhibits are attached:

Figure No.	1	Location Map
	2	Seismic Structure Map of Cambrian Horizon
	3	Seismic Structure Map of "P" - Base of Mesozoic Horizon
	4	Seismic Structure Map of "C" - Transition Beds Horizon
	5	Seismic Variable Density Cross-section - Line "FV"
	6	Inferred Stratigraphic Column

Yours very truly,
DELHI AUSTRALIAN PETROLEUM LTD.

By Charles T. Casley
Resident Manager

CTC:as

BC: S.A. Mines Department ✓
Santos Limited
N.C. Miller
Exploration Technical File

Delhi Australian Petroleum Ltd.
Santos Limited

Kalladeina No. 1
Attachment No. 1

PROGRAMME OF DRILLING OPERATIONS

1. (a)	Proposed Well Name:	Delhi-Santos Kalladeina No. 1
(b)	Location: (approximate)	On Shotpoint "MA" 101 Eromanga-Frome Seismic & Gravity Survey, 1966
		Latitude 27° 39' 24" South Longitude 139° 23' 51" East
		Elevation 108 feet ground level 124 feet kelly bushing
(c)	Programmed Depth:	12,000 feet
(d)	Geological Objectives:	Test of Lower Paleozoic strata
(e)	Estimated Spud-in Date:	March 15, 1967
(f)	Estimated Moving in and Rigging up time:	21 days
(g)	Drilling Contractor:	Drilling Contractors (Australia) Pty. Ltd.

2. Access and Site Preparation

(a) Road Construction:

(i) The road gang will improve and widen approximately 150 miles of new road between the Moomba field and the Kalladeina No. 1 location.

(ii) The length of this move involves travel through sand dunes and clay flats. Each section of the road will be worked individually in accordance with good road building practices.

(iii) Road work will be done primarily with Delhi-Santos road equipment, with assistance of road building contractors if necessary.

(b) Airstrip Construction:

(i) An airstrip will be constructed as close to the drillsite as terrain will permit.

(ii) The strip will be constructed according to D.C.A. requirements to accommodate planes up to the size of a DC3.

(iii) The strip will be constructed by Delhi-Santos construction equipment.

(c) Other Access Construction:

Necessary roads to provide access to the airstrip and water wells will be constructed. Actual location of the water wells and airstrip has not been determined.

(d) Site Preparations:

The drillsite will be located in a relatively flat area which will require a certain amount of levelling before the rig is moved in. It will be necessary to dig a mud reserve pit, sump and a water storage pit at the drillsite.

3. Water Supply

It will be necessary to drill water supply wells for this well to ensure adequate water for drilling.

(i) Three wells will be completed as close to the drillsite as possible.

(ii) Water is expected to be found at 250 feet, more or less.

(iii) The water wells will be cased with 6" 11.64 lb/ft water well casing.

(iv) The water will be pumped into a reserve pit dug at the water well location, using beam type pumping units and plunger pumps on rods inside 4" OD tubing.

(v) The water will be pumped to the drillsite through 4" aluminium pipe from the water pit.

(vi) The water wells will be drilled, cased, completed and equipped by a water well rig contracted from Norwood-Bagshaw Engineering of Adelaide, S.A.

4. Hole and Casing Programme

(a) Surface Casing:

(i) Hole diameter 17-1/2"

(ii) Casing:

Size:	13-3/8" OD
Type:	Oilwell-Seamless Steel
Weight:	48 lb/ft.
Grade:	H-40
Approximate setting depth:	700'
Cementing proposal:	
Sacks	700
Expected to rise to surface	

Cementing will be done by Halliburton Ltd. using a twin T-10 pumper and HOWCO Triplex pumps capable of 10,000 psi.

(b) Intermediate Casing:

(i)	Hole Diameter	12-1/4"
(ii)	Casing:	
	Size:	9-5/8" OD
	Type:	Oilwell-Seamless Steel
	Weight:	40 lb/ft, 43.5 lb/ft and 47 lb/ft.
	Grade:	N-80
	Approximate setting depth:	7,000'
	Cementing proposals:	
	Sacks:	(Volume of cement necessary
	Expected cement tops:	(to bring the top of the (cement 200' above the (highest indicated producing (horizon, such calculations (to be based on caliper log (measurement of the hole (diameter plus a 25 percent (additional volume for (safety.

Cementing will be done by Halliburton Limited using a twin T-10 pumper and BOMCO Triplex pumps capable of 10,000 psi.

(c) Production Liner:

(i)	Hole Diameter	8-1/2"
(ii)	Casing:	
	Size:	7" OD (Liner)
	Type:	Oilwell-Seamless Steel
	Weight:	29 lb/ft.
	Grade:	P110
	Approximate setting depth:	Below any oil or gas bearing zones of commercial value
	Brown Oil Tool special deep hole liner setting assembly (9-5/8" x 7")	
	Cementing proposals:	
	Sacks	(Same procedure as for
	Expected cement rise	(intermediate string

Cementing will be done by Halliburton Limited using a twin T-10 pumper and BOMCO Triplex pumps capable of 10,000 psi.

(d) Casing Head Housings:

Make:	C.C.T.
Models:	C-22
Flange Size:	12" 900 series x 13-3/8" SR thread
Working Pressure:	3,000 psi

(e) Bits (Drilling and Coring):

Size	Make	Type	Quantity
17-1/2"	Reed	YT3A	2
12-1/4"	Smith	OTSJ	1
12-1/4"	Smith	DT2GHJ	2
12-1/4"	Smith	K2PHJ	2
12-1/4"	Smith	SV2HJ	4
12-1/4"	Smith	T2HJ	5
12-1/4"	Smith	L4HJ	15
12-1/4"	Smith	C2HJ	10
8-1/2"	Security	S3J	8
8-1/2"	Smith	DT2GJ	2
8-1/2"	Smith	DT2GHJ	7
8-1/2"	Smith	K2PHJ	1
8-1/2"	Security	H7HJ	15
8-1/2"	Security	H10J	10
8-1/2"	Smith	TC9J	10
8-7/16"	Christensen	Diamond	2
7-3/4"	Christensen	Diamond	1

5. Details of Rig

Plant and equipment owned by: Drilling Contractors (Australia) Pty. Ltd., Sydney, Australia.

(a) Draw Works:

Make:	National
Type:	80D
Rated Capacity: (4-1/2" OD DP)	12,000 feet

(b) Mast/Derrick:

Make:	Lee C. Moore
Type:	136 ft.
Rated Capacity:	830,000 lbs.

(c) Rotary Table:

Make:	Oilwell
Type:	Model 26" M.D.
Size:	26" opening

(d) Engines:

Make:	Superior
Type:	(2) PTBS.6 (2) PTG.6
H.P.:	1,750

(e) Mud Pumps:

Make:	National
Type:	(2) C-700 7-1/4" x 14" (1) C-250 7-1/4" x 15"

(f) B.O.P.:

Make:	Cameron	Hydril
Model:	Double pneumatic	G.K.
Size:	10" 1,500 series	12" 900 series
Working Pressure:	5,000 psi	3,000 psi
Make:	Shaffer Rotating Head (for Air Drilling)	
Model:	Type 50	
Size:	12" 900 series	

(g) Drill Pipe

Size and Make:	4-1/2" OD Spang
Type:	4-1/2" Full Hole
Weight:	16.6 lbs/ft.
Grade:	E
Range:	2

(h) Drill Collars:

Diameter:	8" OD	6-3/4" OD
Bore:	3" ID	2-7/8" ID
Length:	30 ft.	30 ft.
Number:	12	30

(i) Core Barrels:

Make:	Christensen 6-3/4" x 4" x 60 ft. double tube core barrel. Series 250P complete with safety joint and handling tools
Length:	60 ft.
Number:	(2) Serial Nos. 1407 and 1427

(j) Air Drilling Equipment:

It is proposed that upon reaching the top of Lower Paleozoic rocks a core will be cut in order to determine the lithology, structure and, if possible, the age of the sequence. If the available data indicate that the underlying section can be drilled successfully with air as the circulating medium, a contract will be entered into for the air drilling equipment described below and a copy of the contract furnished to the Bureau at that time. The air drilling equipment is stacked in Adelaide, South Australia, and during the period it is being moved to the Kalladeina No. 1 location, the well will continue to be drilled with mud.

The Air Drilling Equipment is owned by International Air Drilling Company, Fort Worth, Texas, U.S.A. The following equipment will be used to drill a portion of the hole with air:

3 — 860 SCFM 250 psi Primary Air Drilling Units, each being a Gardner Denver R&N compressor powered by a General Motors 12V71 diesel engine.

1 1,200 psi Air Drilling Booster Unit, being a Gardner Denver RLD compressor powered by a General Motors 8V71 diesel engine.

1 Chemical Injection Unit

1 Shaffer type 50, 12" 3,000 psi rotating B.O.P.

1 Mobil Air Drilling workshop complete with tools, spare parts and operating supplies adequate for 12 months independent operations in remote locations in Central Australia.

1 Deaerator Unit, with blooie by-pass and aeration control manifold.

1 Air line with valves, chokes, check valves and by-passes designed for efficient and safe rig-up and operation.

6. Transportation (Tonnage and Distances Moved)

Rig and equipment to be moved from the Moomba Field and from Adelaide, South Australia.

	Miles		
	Road	Air	Tonnage
Rig and associated plant	150		700
Casing	780		155
Mud Materials	780		03
Cement	780		75
Camp, equipment, etc.	150		60
Personnel	-	550	-
Air Drilling Equipment	780		75

All equipment will be moved out on completion of the well to a drillsite not yet determined.

7. Mud Programme

The well will be drilled using clear water to the top of the Transition zone at approximately 4,250 feet. An organic thinner, FE8TH, and drilling detergent will be added to control viscosity and hydration of shales. Below this depth the mud will be additionally treated with chemicals to control its physical properties using Q-Broxin and CC-16 until intermediate casing depth is reached. After intermediate casing is set, the well will be drilled using air as a circulating medium. The following materials will be placed on site before commencement of drilling operations:

Mud Materials	Quantity Lbs	Sacks	Tons
FE8TH	2,240	50	1.0
Drilling Detergent	700	100 gal.	.3
Gel	40,000	400	17.9
Q-Broxin	30,000	600	13.4
CC-16	15,000	300	6.7
Bi-Carbonate of Soda	2,168	23	1.0
Caustic Soda	7,700	55	3.4
Calcium Chloride	3,360	24	1.5
Sodium Chloride	4,950	45	2.2
Barytes	60,300	1,070	26.9
Celloseal	1,450	58	0.6
Magco Fibre	7,900	158	3.5
Lime	8,450	150	3.8
Sodium Bi-Chromate	2,240	5 drums	1.0
			83.2

8. Ditch Samples

(a) Ditch Samples will be caught as follows:

(i)	Surface to Transition Zone	30 foot intervals
(ii)	Transition Zone to Total Depth	10 foot intervals
(iii)	During Coring	5 foot intervals
(iv)	While Circulating	15 minute intervals

(b) One set of samples will be washed and retained for use at the wellsite. Bagged samples will be re-washed and divided into required sets at the Company's Adelaide Warehouse and one set will be forwarded to the Bureau of Mineral Resources.

9. Coring

(a) Programme

A core will be taken in the Halloon for lithologic and paleontologic purposes.

A core will be taken in the Hutton for lithologic and paleontologic purposes.

A core will be cut upon reaching the Lower Paleozoic rocks. In this sequence, cores will be cut for stratigraphic, structural and reservoir information. The cores will be cut at convenient bit change depths and as nearly as practicable at 300' intervals. In sections of uniform lithology, agreement will be requested for an extension of the coring intervals.

Cores will also be cut at any horizon if necessary to further evaluate hydrocarbon shows.

If any drill stem tests flow oil or gas in significant quantities, the reservoir will be continuously cored until the hydrocarbon bearing interval has been fully penetrated.

A bottom hole core will be cut.

The specific programme is proposed as follows:

Formation (predicted top)	Number and Length of Cores
Walloon (5,250 feet)	1 x 10 feet
Hutton (5,550 feet)	1 x 10 feet
Lower Paleozoic (6,600 feet)	1 x 10 feet at top plus estimated 16 x 10 feet cores
Total Depth (12,000 feet)	1 x 10 feet

(b) Core Diameters and Length

All coring will be with diamond coring equipment, taking cores approximately 4" in diameter. Diameter of conventional cores, if any, will be at least 2-3/8". Minimum length of cores will be 10 feet, except in the case of extremely hard formations, when, if the coring rate is very slow, shorter cores will be cut.

(c) Recovery

A second core will be cut if recovery on the first run is considered by the wellsite geologist to be inadequate.

(d) Sidewall Sampling

A Schlumberger sidewall sampling gun will be available on location for use if required.

10. Deviation

Surveys will be made at intervals not exceeding 500 feet as drilling progresses. If the changes in deviation set out below are exceeded between successive surveys, the previous 500 feet of hole shall be surveyed at shorter intervals. The changes between surveys indicated below will not be exceeded in distances less than 100 feet. The changes may be reduced proportionately for recordings taken at intervals of depth of less than 100 feet, but intervals of less than 30 feet will not be used.

Depth Interval	Change in Deviation
First 1,000' above T.D.	$3\text{-}3/4^{0}$
Next 1,000' higher	$3\text{-}3/4^{0}$
Next 1,000' higher	2^{0}
Remaining interval to surface	$1\text{-}1/2^{0}$

11. Wellsite Laboratory Services

(a) Mud Control

Mud checks are made at least 3 times daily. The following properties are measured on each mud check:

Funnel viscosity	Yield Point
Weight	10 second gel strength
Water Loss	10 minute gel strength
Filter Cake Thickness	pH
Apparent Viscosity	Solid content
Plastic Viscosity	Sand content
	Chloride content

Equipment available to run mud checks is as follows:

Filter Press	Mud Balance
Viscosimeter Funnel	Fann V-G Motor
Sand Content Set	Mud Still

(b) Gas Detection

(i) Name of Service Company: Exploration Logging of Australia Inc.

(ii) Equipment to be used: Portable Automatic Gas Detector

(iii) Data to be provided: Continuous detection of gas in mud stream

(c) Penetration Rate

(i) Name of Service Company: Operator owned

(ii) Equipment to be used: Geolograph Recorder

(iii) Data to be provided: Continuous depth record and rate of penetration graph

(d) Cuttings Analysis and Fluorescence detection

A fully equipped and manned geological laboratory is maintained on location. Microscope, ultraviolet light and other standard equipment for analysis of cuttings and shows is available.

12. Logging and Surveys

	Run 1	Runs 2 - 4 Schlumberger Logging
Gamma Ray-Bore Hole Compensated Sonic, Caliper	500 - 7,000	7,000 - 12,000
Induction-Electric	500 - 7,000	Only the Gamma Ray and Density logs will be run during air drilling operations. There will be 3 runs 2,000 feet or less apart. Following the running of these logs at Total Depth the hole will be filled with mud and the Induction, Electric, Sonic and Continuous Dipmeter will be run. If the lithology and fluid content of the rocks make it desirable, the Laterolog and Proximity Logs will be run over zones of interest.
Proximity Log	Over prospective porous zones	
Density	500 - 7,000	
Continuous Dipmeter	500 - 7,000	
Casing Collar Locator	If production casing is set	
Velocity Survey	(In conjunction with Seismic Contractor) At Total Depth	

13. Formation Testing

(a) Programme

All shows of oil or gas will be drill stem tested as soon as detected. In the general case of porosity without shows, drill stem tests may be run to provide reservoir data or to eliminate any doubt as to hydrocarbon content. All doubtful situations will be tested.

(b) Equipment

D.S.T. equipment on location will be:

2 Halliburton No. 3 Wall Packers
2 Halliburton No. 2 Wall Packers
1 Halliburton RTTS for 9-5/8" OD Casing
1 Halliburton Type C Hook Wall Packer for 7" Casing
1 Halliburton 5" Hydrospring Test Tool Assembly
1 Halliburton 5" Dual C.I.P. Valve Assembly
2 Halliburton BT Recorders, Range 0 - 10,000 psi
1 Halliburton BT Clock, 24 hour
1 Halliburton BT Clock, 12 hour

Separation equipment:

1 Skid-mounted National Tank Co. two stage two phase separator unit with 3" orifice run on high pressure gas outlet.

14. Abandonment

In the event the well is a dry hole, it will be plugged according to the South Australian Mines Department plugging procedures.

15. Personnel

(a) Shifts to be run:

Daily	3
Weekly	21
Hours per shift	8

(b) Drilling Crew

Toolpusher	1
Rig Mechanic	1
Drillers	4
Rotary Helpers	12
Derrickmen	4
Air Drillers	2

(c) Other On-site Labour

Cooks	3
Others	10

(d) Administration, etc.

Drilling Foreman and Mud Engineer	C.T. Skov
Wellsite Geologist	N. Papalia, alt.
	O. Nugent
	A. Kapel
Petroleum Engineer	E.F. Spinks

(e) Accommodation

The camp, presently located at the Moomba field, or one similar, will be moved to a point near the Kalladeina No. 1 location. The camp will be completely air-conditioned, and will house 50 personnel. The camp will be supplied with 240 volt electric power and bottled gas for cooking and hot water service.

16. Transport

Furnished by Operator for supervisory personnel:	3 Landrovers 4 Nissan Patrols 1 Oilfield truck complete with winch and gin poles
Furnished by Contractor:	1 Landrover Utility 2 Oilfield trucks complete with winch and gin poles

One DC3, one Cessna 310, Cessna 210's and 185's and other aircraft as required under charter will serve the site from Adelaide.

Delhi Australian Petroleum Ltd.
Santos Limited

Kalladeina No. 1
Attachment No. 2

DRILLING COST ESTIMATE TO TOTAL DEPTH
(12,000 feet)

		$A
Access Construction		25,000
Site preparation and clean-up		1,000
Water Supply		8,000
Transportation - equipment, personnel and consumables		42,000
Rental of truck, moving equipment		2,500
Air Charter		7,200
Drilling Bits - 17-1/2"	750	
12-1/4"	13,600	
8-1/2"	6,831	
6-1/2"	22,400	43,580
Fuel		11,200
Drilling Fluid		15,600
Cement - Class "A"	570	
Class "G"	3,300	3,870
Cementing Services		2,000
Electrical Logging Services		51,140
Mud Logging		1,600
Formation Testing		9,000

Delhi Australian Petroleum Ltd.
Santos Limited

Kalladeina No. 1
Attachment No. 2
Page 2

		$A
Rig Rental - 21 days @ $A 448	9,408	
38 days @ $A1,500	57,000	
12 days @ $A1,500	18,000	
3 days @ $A1,358	4,054	
3 days @ $A1,188	3,564	92,026
Air Rental - 20 days @ $A 470	9,400	
800 hours @ $A 12	9,600	
200 hours @ $A 8	1,600	20,600
Other Tool Rentals		5,000
Overhead		7,410
Communications		450
Insurance		6,190
Data Reproduction		2,800
Field Living Quarters and Amenities @ $A320/day		24,640
Miscellaneous		800
Final Reports		2,000
Casing - 700' 13-3/8" 48 lb. H-40 @ $A5.25	3,675	
1,000' 9-5/8" 47 lb. N @ $A5.50	5,500	
4,200' 9-5/8" 43.5 lb. N @ $A5.05	21,210	
1,900' 9-5/8" 40 lb. N @ $A4.80	9,120	39,505
TOTAL "A"		$A425,231

DEPRECIATION:

	Original Cost	Estimated Period (Weeks)	Rate of Depreciation	Amount of Depreciation
Machinery and camp equipment	$72,598	11.0	10%	$1,334
Surface drilling plant and down-hole equipment	302,500	11.0	20%	12,798
	TOTAL "B"			$A 14,332
	GRAND TOTAL ("A" + "B")			$A439,363

Delhi Australian Petroleum Ltd.
Santos Limited

Kalladeina No. 1
Attachment No. 2(a)

MACHINERY AND EQUIPMENT

	$A
Plumbing and Water Supply Equipment	3,060
Plumbing Equipment	9,412
One Caterpillar 212 Grader	6,000
One Caterpillar 922 Front End Loader	17,200
One Caterpillar D6C Dozer	30,660
One Ajax multi-stage centrifugal Pump powered by a Caterpillar D320 Engine	5,044
Air Compressor	342
Electric Welder	880
TOTAL	$A72,598

Delhi Australian Petroleum Ltd.
Santos Limited

Kalladeina No. 1
Attachment No. 2(b)

SURFACE DRILLING PLANT, BOREHOLE EQUIPMENT AND CAMP

	$A
Automotive Equipment and Spares	3,600
Mechanic's Leanto and Caravan Unit 34	3,816
Miles Building (Schlumberger Warehouse)	894
Electrician's Caravan Unit 33	2,726
Kitchen Caravan Store Unit 35	5,008
Fittings, Spares, Dishes, Utensils, and other small equipment to furnish camp amenities	12,040
One Caterpillar D-1300 6 cylinder 100 KVA 240 volt Generating Plant	6,810
Two Caterpillar D333C 240 volt generating sets	15,564
One skid-mounted Generator House	3,600
Spares, Fittings, and Accessories for the camp electrical and refrigeration system	10,048
Radio Communication Equipment	7,000
4 10' x 40' 10-man Bunkhouses	28,000
1 10' x 40' Bunkhouse, Office and First Aid Caravan	6,950
1 10' x 40' 6-man Bunkhouse	7,192
1 10' x 40' Bunkhouse and Office	6,740
1 10' x 40' Geologic and Engineering Laboratory and Bunkhouse	7,748

	$A
1 10' x 40' washcar, laundry and toilet unit	9,470
1 10' x 40' kitchen cooler unit	17,010
1 10' x 40' diner storage unit	6,160
1 10' x 40' diner canteen unit	7,020
1 "Rightways" semi-trailer van	2,356
Reamer stabilizers and stabilizers	6,972
Fishing tools	18,400
Eleven 6" drill collars	7,950
High and Low pressure separator and test tank	10,700
2 Christensen and 1 Hycalog core barrels	14,202
Casing head	672
Spares, accessories and parts for surface and downhole equipment	8,100
21,000' 4" victaulic water line with housings	15,830
26,000' 4" aluminium water line with housings	13,970
2 4 x 4 Leyland Comets	12,685
1 4 x 4 Chevrolet Blitz Water Tanker	2,200
2 Nissan Patrol four-wheel drive vehicles	6,140
5 Landrover four-wheel drive vehicles	14,921
TOTAL	$A302,500

GEOLOGY

The Kalladeina anticline is located on the western flank of the Cooper's Creek geologic basin and to the east of the large regional Birdsville Track basement high. The nearest wells are FPC(A) Poonarunna No. 1, 38 miles west-southwest, which bottomed in sediments of presumed pre-Cambrian age; the Delhi-Santos Pandieburra No. 1 well, 63 miles to the north, which drilled into Ordovician rocks; and the Gidgealpa gasfield wells, 47 miles to the southeast, where sediments of Cambrian age underlie the Permian. The Kalladeina anticline is an elongate, fairly simple, low relief structure trending northeast-southwest. At the -10,700 foot level, geophysical mapping indicates more than 400 feet of vertical closure and approximately 30 square miles are included within the lowest closing contour.

The Kalladeina anticline was discovered by reconnaissance reflection seismic surveys (Line "FV", Figure 5), carried out during the Strzelecki-Cooper Seismic & Gravity Survey (1965). This programme was designed to further define the Cooper's Creek basin, and in particular, to map in areas where reliable pre-Permian reflections could be recorded. A large reversal of strong pre-Permian reflections was detected in the general area of the Kalladeina artesian water bore, and this structural lead was brought to its present stage of definition during the Eromanga-Frome Seismic & Gravity Survey (1966).

The initial location selected for an exploratory well is near the crest of the deep anticlinal closure at Shotpoint 101 on Line "MA".

In considering the stratigraphic units to be penetrated in the Kalladeina No. 1 well, it should be kept in mind that their thickness and their very presence is based solely on geophysical data tied to very distant points of subsurface geologic control.

Mesozoic

The Mesozoic sediments are extremely uniform in lithology and general thickness over vast areas of the western Great Artesian basin, beneath which lies the Cooper's Creek basin.

The Jurassic and Cretaceous sandstones are not considered prospective on this structure. However, these sediments will be carefully evaluated by sample analysis and continuous recording mud gas detector during drilling.

The only Mesozoic sequence in the area which to date has given any real encouragement in the search for petroleum is the Lower Triassic, but the unit is not expected to be present in this well, or if present, to be very thin.

Permian

It is believed that Kalladeina No. 1 is located to the west of the Permian portion of the Cooper's Creek basin and, therefore, sediments of Permian age are not expected. In the unlikely event they are present, they will be fully evaluated.

Lower Paleozoic

The nature, thickness and age of the Lower Paleozoic rocks are unknown at Kalladeina. Good seismic reflections from as deep as 4,000 feet below the regional unconformity at the base of the Mesozoic, show the Paleozoic rocks to be only gently folded.

Any attempt to predict the sequence is somewhat speculative and is based solely on very long range regional geological projections. Some Ordovician marine sediments may be present, probably as fine-grained clastics similar to those drilled in the Pandieburra No. 1 well to the north. Favourable development of porosity is always a possibility in rocks of this type.

A good seismic reflection at about 7,200 feet may represent the top of Cambrian sediments. Cambrian lithology will probably consist of shales and carbonates of the Gidgealpa sequence. It is possible that some sandstones will also be present (sands comprise a significant part of Cambrian sequences in adjacent regions). Seismic evidence of thickening of the probable Cambrian to the north and west indicates that during deposition the basin was actively subsiding in that direction. Thinning over the structure itself (lines "M" and "N") implies its early existence. There has been subsequent tilting to the southeast and development of the Kalladeina anticline and other structures along an extensive trend in the western parts of the Cooper's Creek basin. The epeirogenic activity during and after deposition should have produced conditions favourable to the development of a variety of carbonate and clastic reservoirs and also for the migration of hydrocarbons into available traps.

Seismic data also shows that the upper portion of the Lower Paleozoic sequence exhibits both depositional and erosional wedging-out on the eastern flanks of the structure. Thus, there are excellent chances for stratigraphic traps, in addition to the anticlinal trap.

As the stratigraphy on the Kalladeina anticline is completely unknown, the well is programmed to 12,000 feet in order to penetrate the full sequence of strong continuous seismic events. Air drilling is proposed below 7,000 feet.

GEOPHYSICS

Gravity and Magnetics

The Kalladeina structure is situated in a gravity low and a magnetic low and cannot be easily identified as a structure on either the magnetic total intensity or the Bouguer gravity maps. Reviews of magnetic data show that the nearest magnetic basement depth estimates east and west of the Kalladeina structure are values of -13,200 and -8,500 feet respectively. The basement below the structure has been interpreted to be at approximately -12,000 feet, which is in general agreement with the depth of the base of reflections. The Bouguer gravity anomaly produced by this structure is apparently obscured by the strong gravity gradient effect of the large fault just west of, and parallel to, the structure. A gravity derivative map of the area shows a positive feature which approximates the Kalladeina structure. The major gravity maximum and seismic high mapped west of the fault lacks pre-Mesozoic reflections and is associated with a shallow magnetic basement (-8,500 feet). (See References 3 and 4).

Seismic

Reconnaissance reflection seismic surveys along the western flank of the Cooper's Creek basin indicated the possibility that a large anticline existed in pre-Permian rocks in the Kalladeina area. Continuous reflection profiling in the area confirmed the presence of the structure.

Pre-Mesozoic reflections are stronger and more continuous here than in most of the Cooper's Creek basin, due wholly or partly to the absence of the strongly reflective Permian section. Inspection of Sonic logs at Gidgealpa reveals a number of significant velocity contrasts in the Cambrian, and it is believed that most or all of the pre-Mesozoic reflections at Kalladeina represent this section.

Data quality varies from good to poor over the area mapped, with the majority being fair. The poorest data are on Line "MC", on parts of Line "MI", on the east end of "MD", and on "MO" and "FV" near the large down-to-the-east fault.

Structural contour maps have been prepared at Transition Beds (Fig. 4), Base of Mesozoic (Fig. 3), and probable Cambrian levels (Fig. 2). The two shallower horizons probably have only minor significance in analysis of the structure. The "P" or Base of Mesozoic map, represents an erosional surface, and the formations of interest are below this unconformity. The time-depth curve used to convert "C" reflection times to depth was essentially that devised by a study of all wells in the region. This checked closely with a delta-T analysis of reflections in the Kalladeina area. To obtain "C - P" intervals, a time-thickness curve also representative of the wells was used. From the "P" to Cambrian horizon, an interval velocity of 16,000 feet/second was used.

At the probable Cambrian horizon mapped, the Kalladeina structure appears to have minimum vertical closure of 400 feet and the area within closure is 30 square miles. Pre-unconformity reflections indicate thickening generally west-northwestward across the structure and into the syncline along its western margin (Fig. 5). These reflections all disappear near the large fault at the west edge of the area contoured. More minor faults than shown may be present, but the control established is not adequate to map them with any degree of reliability. The area of the structure appears, by inference from the abovementioned westward thickening, to have been in a basin of significant subsidence. It has since been tilted to the southeast. Lines "MA" and "ME" show north-south thinning over this structure, which implies that the structure was active during deposition.

REASONS FOR DRILLING

The main objective of the Delhi-Santos Kalladeina No. 1 well is to explore for oil accumulations in Lower Paleozoic rocks on a large, gentle, closed anticline. The well is expected to penetrate approximately 5,400 feet of Paleozoic sediments within structural closure. This section is expected to be predominantly marine sediments of Cambrian age, with some Ordovician also possibly present. The Ordovician encountered in other wells drilled in the Cooper's Creek basin has consisted predominantly of grey marine shales, with associated silts and fine sands. Cambrian sediments, as at Gidgealpa and the Northern Flinders Ranges, comprise a very thick marine shelf carbonate and shale sequence, with well developed sands also present in the Amadeus and Georgina basins and Adelaide geosyncline regions. Excellent carbonate porosity is present at Gidgealpa, and hydrocarbon shows are found both on outcrop and in the subsurface.

The well is extremely important from the point of view of future exploration in this part of Australia. The stratigraphy is unknown and if the predicted favourable sediments for the generation and trapping of petroleum are in fact encountered, a very large area becomes highly prospective.

TARGET DEPTH

The proposed Total Depth for Kalladeina No. 1 is 12,000 feet. It is anticipated that the top of Paleozoic rocks will be at 6,600 feet, thus allowing for a penetration of the objective sediments of 5,400 feet, sufficient to penetrate below the depth of all continuous seismic events. Air drilling is proposed to commence no shallower than 7,000 feet, if suitable conditions occur, and to be continued to Total Depth or until an oil or gas reservoir is reached. The appearance of extrusive or intrusive igneous rocks, metamorphic or impenetrable rocks, or of very steeply dipping strata, will be sufficient reason to terminate the drilling at less than Target Depth.

Stratigraphic Prognosis

Formation	Drilling Depth (Feet)
Recent and Tertiary	Surface
Winton	400
Tambo	2,650
Roma	3,650
Transition	4,350
Mooga	4,550
Kalloon	5,250
Hutton	5,550
Lower Paleozoic (Ordovician ?)	6,600
Cambrian (?)	7,250

PRINCIPAL REFERENCES

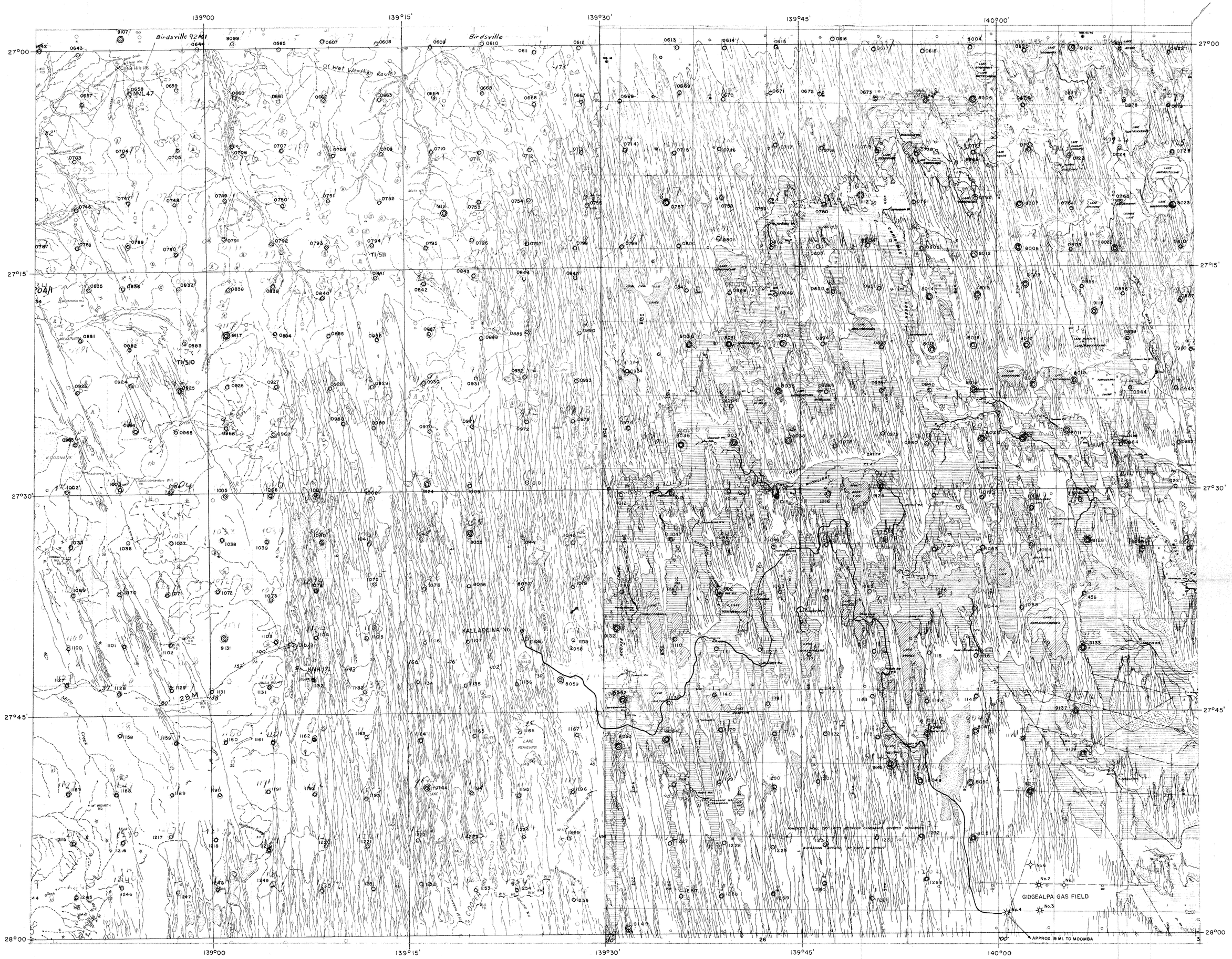
Further details of geology and geophysics pertinent to this application for subsidy are included in the following reports on operations carried out under provisions of the Petroleum Search Subsidy Acts.

Wells

1. Delhi-Santos Cidgealpa No. 1.
2. Delhi-Santos Tandieburra No. 1.
3. FPC(A) Poonarunna No. 1

Geophysical Surveys

1. Strzelecki-Cooper Seismic & Gravity Survey (1965).
2. Eromanga-Frome Seismic & Gravity Survey (1966). Progress Reports.
3. Innamincka-Betoota Aeromagnetic Survey (1961).
4. Lake Gregory-Strzelecki Gravity Survey (1965).



DELHI AUSTRALIAN PETROLEUM LTD.

LOCATION MAP

SHOWING PROPOSED ROAD

FROM GIDGEALPA No.4 TO KALLADEINA No.1

SCALE - 1:250,000

DATE : APRIL 1967

706-1

COMPOSITE WELL LOG

COMPANY **ANY OIL CO PTY LTD**

PETROLEUM TENEMENT **100 F** WELL NUMBER **DRAKE NO. 1**

STATE **NEW VICTORIA** 4-MILE SHEET **DINGO** BASIN **TIMBALE** WELL STATUS **ABANDONED**

LOCATION – Lat. 34°50′S Long. 129°30′E

ELEVATION – Reference Pt. (RT/Floor) 60 A.S.L.

Ground 50 A.S.L.

Date Spudded 1st January 19..

Date Drilling Stopped 14th. July 19..

Date Rig Off. 20th. July 19..

Total Depth Driller 10,000
E. Log

Hole Size

In.	From	To
24″	0′	70′
17½″	70′	600′
12¼″	600′	3000′
8⅝″	3000′	7500′
5⅝″	7500′	10,000′

Casing

In.	Wt.	Gr.	Depth	Cmt.	Cmt'd To
20″	94 lbs	H-40	60′	25 sx	Surface
13⅜″	48 lbs	H-40	690′	200 sx	Surface
9⅝″	40 lbs	J-55	2950′	200 sx	2000′
6⅝″	29 lbs	N-80	7490′	500 sx	4000′

Cement Plugs

From	To	Sacks
120′	140′	5

Perforations

Type	Size	From	To	No/ft
Jet	½″	190′	170′	4
Bull.	½″	90′	75′	4

Well Head Fittings: *Capped with plate and 2″ valve*

Drilled by: *Mid Ocean Drilling Co. Ltd.*

Logged by: *Schlumberger* Cemented by: *Halliburton*

Drilling Method: *Rotary* Mud logging by: *Core Lab*

ELECTRIC LOG DATA

RUN NUMBER	1	2
DATE	4 Jan.	2 Feb.
FOOTAGE LOGGED	538′	2397′
LOGGED FROM	598′	2996′
LOGGED TO	60′	599′
TOTAL DEPTH - ELECTRIC LOG	598′	2997′
TOTAL DEPTH - DRILLER	600′	3000′
CASING SHOE - ELECTRIC LOG	60′	599′
CASING SHOE - DRILLER	60′	600′
BIT SIZE	17½″	12¼″
MUD-KIND	Bentonite	Bentonite
-TREATMENT	Myrtan	Caustic/Myr
WATER LOSS ccs/30 min.	6	4
WEIGHT lbs/cu. ft.	72	86
VISCOSITY (Marsh) Sec.	50	47
pH	8	11
RESISTIVITY Ω m²/m & TEMP	3.5 @ 72°F	3.4 @ 75°F
	2.7 @ 135°F	2.5 @ 150°F
MAX. RECORDED TEMPERATURE	135°F	150°F
ELECTRODE SPACING	16″	16″
SYMMETRICAL	64″	64″
	18′8″	18′8″
NON-SYMMETRICAL	23′-45″	23′-45″
RECORDED BY	J. Smith	J. Doe

RADIOMETRIC LOG DATA

TYPE OF LOG	GRN
RUN NUMBER	1
DATE	2 Feb.
TOTAL DEPTH - DRILLER	3000′
TOP OF LOGGED INTERVAL	100′
BOTTOM OF LOGGED INTERVAL	2998′
TYPE OF FLUID IN HOLE	Mud
FLUID LEVEL	Surf
MAXIMUM RECORDED TEMPERATURE	150°F
NEUTRON SOURCE, STRENGTH & TYPE	GNAM 5
SOURCE SPACING - IN.	5
LENGTH OF MEASURING DEVICE	8″
O.D. OF INSTRUMENT - IN.	4½
TIME CONSTANT - SECS.	4-4
LOGGING SPEED - FT/MIN.	16
STATISTICAL VARIATION - IN	0.5 @ 2500
SENSITIVITY REFERENCE	400/100
RECORDED BY	J. Doe

CASING RECORD

RUN NO.	SIZE - IN.	WT. - LBS.	INTERVAL - FT FROM	INTERVAL - FT TO
1	20	94	Surf.	60

OPEN HOLE RECORD

BIT SIZE - IN.	INTERVAL - FT FROM	INTERVAL - FT TO

LITHOLOGIC REFERENCE

- Conglomerate
- Breccia
- Tillite
- Quartz sandstone
- Arkose
- Greywacke
- Siltstone
- Claystone
- Shale
- Limestone
- Dolomite
- Calcarenite
- Calcilutite
- Marl
- Evaporite s: Salt
- Coal
- Igneous rocks gr: Granite
- Volcanic rocks b: Basalt
- Metamorphic rocks gn: Gneiss
- mi: Micaceous
- cal: Calcareous
- gl: Glauconitic
- py: Pyritic
- c: Carbonaceous
- ch: Cherty

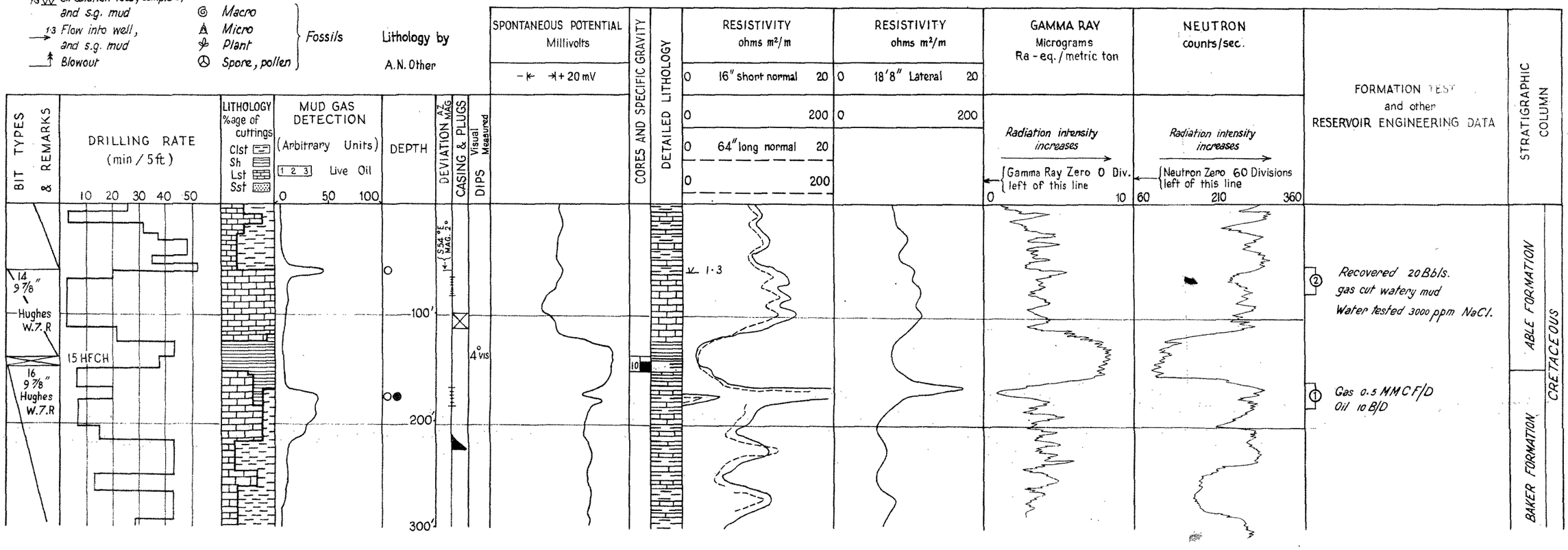
WELL SYMBOLS

- Gas show, slight
- Gas show, strong
- Oil show, slight
- Oil show, strong
- Oil and gas show
- Fluorescence
- Circulation loss, partial, and s.g. mud
- Circulation loss, complete, and s.g. mud
- Flow into well, and s.g. mud
- Blowout
- Core, interval, number and recovery
- Sidewall core
- Perforated interval
- Formation test interval, and no. (① O.H. ② in csg.)
- Plugged interval
- Fossils: Macro, Micro, Plant, Spore, pollen

Lithology by A.N. Other

OTHER BORE-HOLE LOGS

Temperature	60′ to 550′	Run 1
Micro-Caliper	2997′ to 599′	Run 1,2,3
Velocity	2997′ to 599′	Run 1



706-2

706

HORWOOD BAGSHAW ENGINEERING PTY. LTD.

157 Edward Street, Edwardstown
South Aust.

WELL DRILLING CONTRACTORS AND HYDRAULIC ENGINEERS

BORE LOG

Bore for M. DELHI (AUS) PETROLEUM LTD. Location KALLADEINA A, B & C BORES

Drillers IAN BARTON. Name of Property

Commenced 28-1-67 | Completed 9.2.67. | Depth Bored 210'

CASING IN BORE

Diam.	Length	Brand
6"	200' 2"	A BORE
"	199' 3"	B "
"	200' 1"	C "

Shoe Used

Casing Clamps Size Type

PUMPING TEST

	1st Test	2nd Test	Final Test
Gallons per hour	900		
Water Level before Pumping	33'		
Water Level when Pumping	85'		
Duration of Test	6 HRS		
Depth to Pump	120'		
Size of Pump used and Type	PLUNGER.		

REMARKS

BORES IDENTICAL IN STRATA AND DEPTH.

Thickness of Strata Feet	Ins.	Strata	Depth Feet
9'		WHITE SAND	9'
9'		WHITE SANDY CLAY	18'
4'		YELLOW CLAY	22'
3'		WHITE SAND	25'
8'		WHITE SANDY CLAY	33'
11'		RED SANDSTONE	44'
9'		WHITE SAND	53'
6'		YELLOW SAND	59'
13'		YELLOW CLAY	72'
6'		GREY CLAY & KOPI	78'
14'		WHITE SAND	92'
5'		WHITE CLAY	97'
8'		YELLOW SAND	105'
11'		PINK CLAY	116'
14'		YELLOW CLAY	130'
4'		WHITE SAND	134'
2'		GREY CLAY	136'
5'		GREY SHALE	141'
4'		WHITE SAND	145'
11'		BROWN CLAY	156'
3'		WHITE SAND	159'
9'		PINK CLAY	168'
13'		GREY CLAY	181'
17'		WHITE CLAY	198'
13'		WHITE SHALE	211'

S.W.L. 33'

6" BORE CASING.
A. 200' 2"
B. 199' 3"
C. 200' 1"

WATER STRUCK — Struck at / Rose to (Feet from Surf) — Supply

FB 2652—250 2/65. Form No. 7

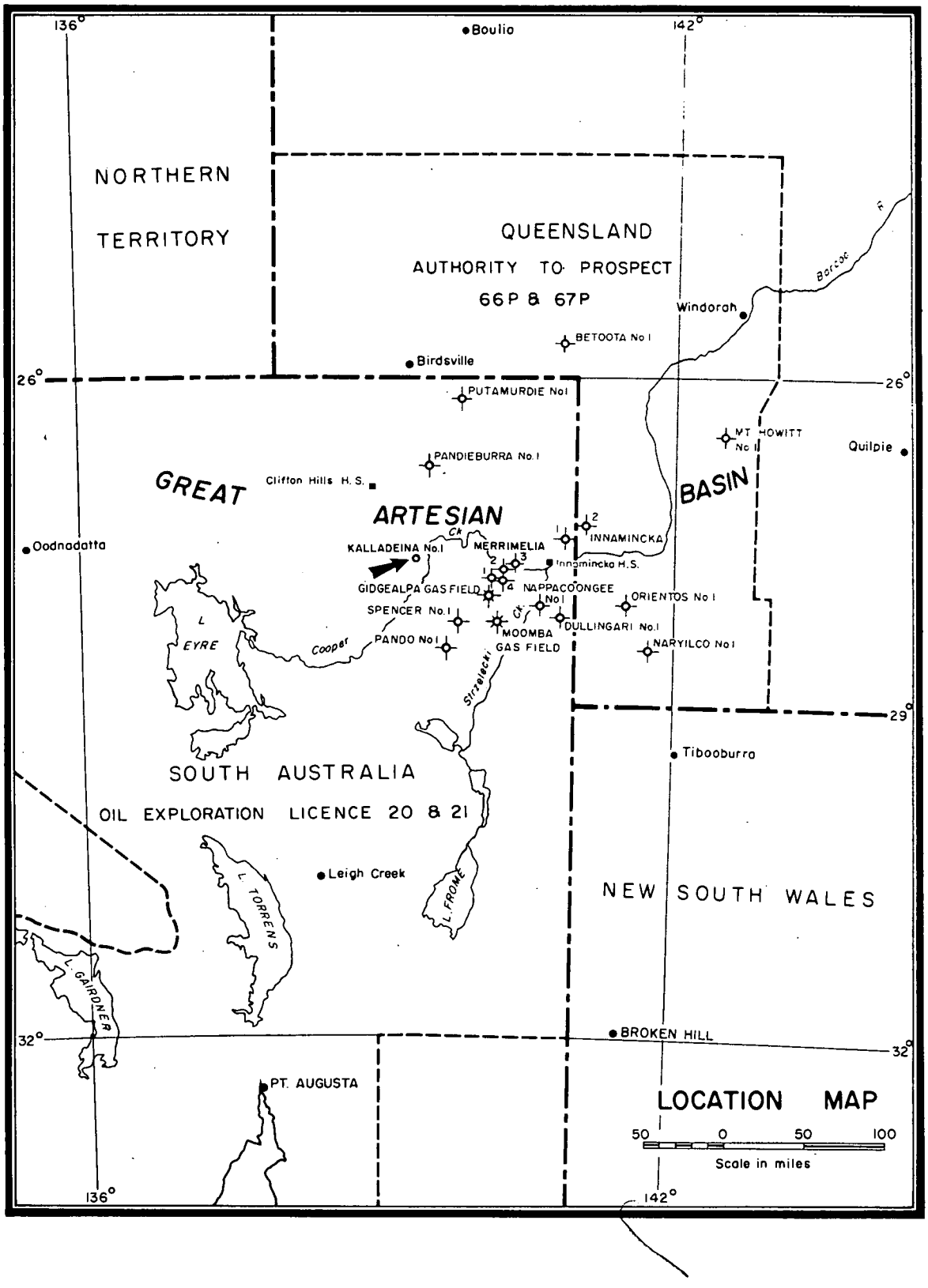
Entered by JEE.

DATE 27.2.67

706-3

HORWOOD BAGSHAW ENGINEERING PTY. LTD.
157 EDWARD STREET, EDWARDSTOWN, S.A.

Approved



706-4

FIGURE No 1
DUPLICATE

DELHI AUSTRALIAN PETROLEUM LTD.

SEISMIC BASE MAP

OF THE

KALLADEINA STRUCTURE

SOUTH AUSTRALIA

"€" - PROBABLE CAMBRIAN

CONTOUR INTERVAL = 100 FT.

INTERPRETATION BY D.L.BURTON SEPTEMBER 1966

SCALE 1:60,000

5000 0 5000 10,000 15,000 20,000

FEET

706-5

FIGURE No 2

139° 15' 20' 25' 139° 30' 35'

27° 30' 35' 40' 27° 45' 50'

25C-3 25C-2 25C-1 25B-3
25C-4 25C-5 25C-6 25B-4
25C-9 25C-8 25C-7 25B-9
25F-3 25F-2 25F-1 25G-3

-6000 -6100 -6200 -6300 -6400 -6500 -6600 -6700

PROPOSED LOCATION
KALLADEINA No 1

FV MA MD MH MC NF MI

T1/531 T3/522

DELHI AUSTRALIAN PETROLEUM LTD.

SEISMIC BASE MAP

OF THE

KALLADEINA STRUCTURE

SOUTH AUSTRALIA

"P"- BASE OF MESOZOIC

CONTOUR INTERVAL = 100 FT.

INTERPRETATION BY D.L.BURTON SEPTEMBER 1966

SCALE 1:60,000

5000 0 5000 10,000 15,000 20,000

FEET

706-6

FIGURE No 3

139° 15' 20' 25' 139° 30' 35'

27° 30'

35'

40'

27° 45'

50'

25K-3 25K-2 25K-1 25J-3

25K-4 25K-5 25K-6 25J-4

25K-9 25K-8 25K-7 25J-9

25N-3 25N-2 25N-1 250-3

-3500 -3600 -3700 -3800 -3900 -4000 -4100 -4200 -4300 -4400 -4500

PROPOSED LOCATION
KALLADEINA No 1

FV MA MD MH MC NE MI

T3/522

T1/531

DELHI AUSTRALIAN PETROLEUM LTD.

SEISMIC BASE MAP

OF THE

KALLADEINA STRUCTURE

SOUTH AUSTRALIA

"C" HORIZON

CONTOUR INTERVAL = 100 FT.

INTERPRETATION BY D.L.BURTON SEPTEMBER 1966

SCALE 1:60,000

5000 0 5000 10,000 15,000 20,000

FEET

706-7

FIGURE No 4

LINE FV62-001

PROJECTED LOCATION
KALLADEINA Rd.

FIGURE No.

S.P. Nos 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 S.P. Nos

SE SE

+200' +100' 0 -12 mg -14 -16 -18 mg

Surface

Bouguer gravity

N.S.

PARTLY ERASED TAPE

TIME

0.5 1.0 1.5 2.0 2.5 3.0

TRANSITION

BASE OF MESOZOIC

UNITED

UNITED

STRATA-PRINT

STRZELECKI-COOPER
SEISMIC SURVEY
LINE FV PART 2

Magnetic Tapes
by
UNITED
GEOPHYSICAL
Party 133
for
DELHI AUSTRALIAN PETROLEUM LTD.

TRANSCRIPTION DATA
Recording filter 18
Playback filter 5-7
Mix 0 %
Film speed 5 "/sec

STRATAPRINT DATA
Datum elevation Sea level
Velocity function
Vo = 5000'/sec
Com = H

StrataPrint zero = 0.0 Sec.
Tracks / in = 12
Serial No. 1207
DECEMBER 14, 1965
Horizontal Scale 1" = 1320'

SHOT HOLE LEGEND

C = Clay
G = Gravel
S = Sand
SC = Sandy Clay
SS = Sandstone
SH = Shale
LS = Limestone
RK = Rock

706-8

DELHI AUSTRALIAN PETROLEUM LTD.

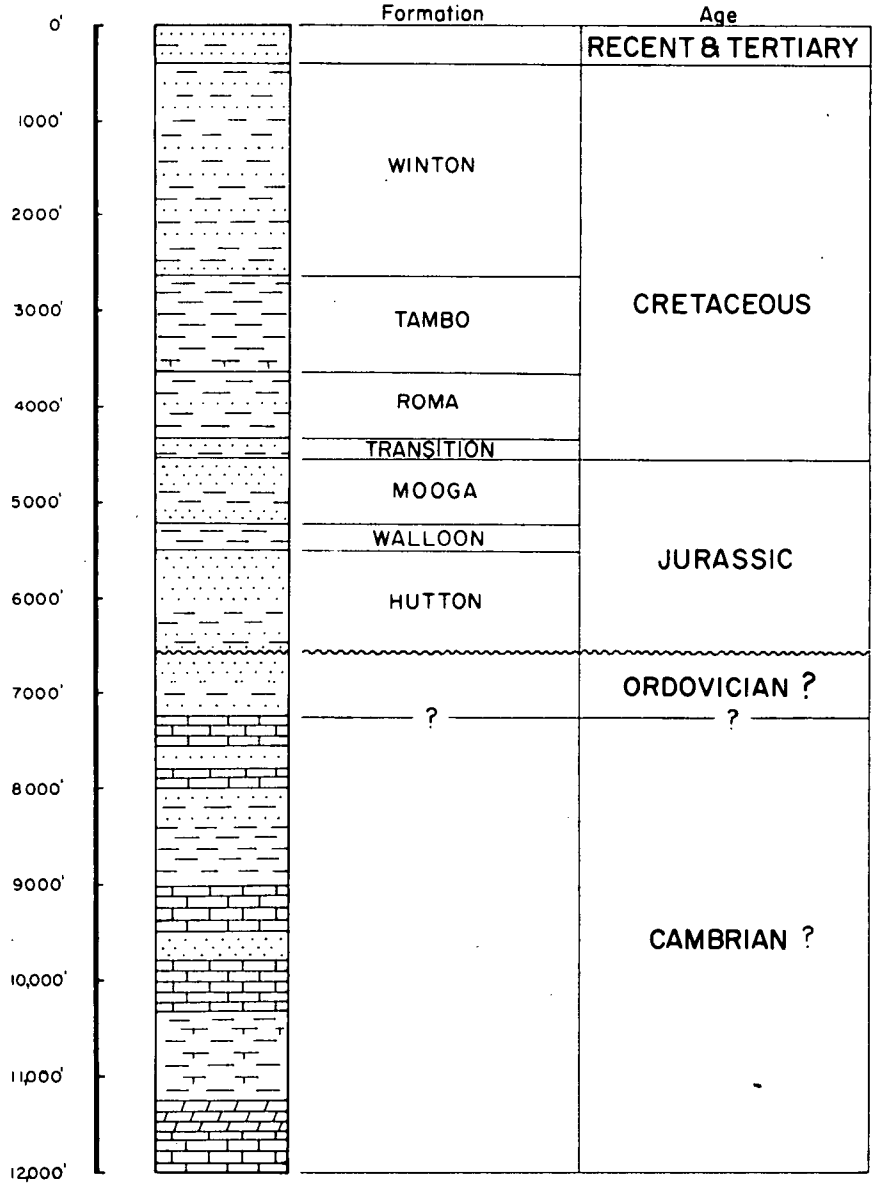
DELHI - SANTOS KALLADEINA No. 1

SOUTH AUSTRALIA

LAT. 27° 39' 34"
LONG 139° 23' 51"

ELEVATION 108. GL. APP.

INFERRED STRATIGRAPHIC COLUMN



706-9

FIGURE No 6

ENV 706

040

Delhi Australian Petroleum Ltd.
Santos Limited

Kalladeina No. 1
Attachment No. 1
Revised April 26, 1967

PROGRAMME OF DRILLING OPERATIONS

1. (a) Proposed Well Name and Number: Kalladeina No. 1

(b) Location:
Latitude: 27°39'24" S
Longitude: 139°23'51" E
Elevation: 108' Ground Level
124' Kelly Bushing

(c) Programmed Depth: 12,000 feet.

(d) Geological Objectives: Test of Lower Paleozoic Strata

(e) Estimated Spud-in Date: June 1, 1967

Drilling Time (days) 99 days

(f) Estimated Rigging up time: 16 days
Estimated Rigging down time: 5 days

(g) Drilling Contractor: Drilling Contractors (Australia) Pty. Ltd.

2. Access and Site Preparation:

(a) Road Construction:

(i) New Grade: Miles: 98 miles

A road will have to be built from Gidgealpa No. 4 to the site. The route was selected after extensive air and ground reconnaissance. A map is attached.

(ii) Method of Surfacing:

All sandy areas will be covered with clay.

(iii) Contractor:

Company equipment working with Watt Brothers Construction Company.

(b) Airstrip Construction:

(i) Area to be cleared:

An area of 31 acres will be cleared.

(ii) Length to be graded:

The DCA requires an airstrip to be 300' wide and 4,500' long and properly marked with wind sock, etc.

(iii) Surfacing:

Good firm clay in place is required.

(iv) Contractor:

The airstrip will be built and maintained by Company equipment.

(c) Other Access Construction:

The 18 miles of road from Moomba to Gidgealpa has filled with sand and will have to be reworked. Both Gidgealpa and Kalladeina roads will have to be maintained to obtain supplies from Adelaide.

(d) Site Preparation:

The site sits in the midst of a large sand area. Extensive work will be needed to level and clay the site.

3. Water Supply:

(a) If from existing source: None

(b) If bore required:

(i) Location:

Three bores have been drilled and cased. This water contains many undesirables and drilling water may have to be trucked from the Cooper River. Attached is a copy of the water analysis.

(ii) Expected depth: 210 feet

(iii) Casing: 6" 11.64 #/ft. 200'

(iv) Pumping equipment:

The water will be pumped into a reserve pit dug at the water well locations by means of beam type pumping units used with tubing, rods, and plunger pumps.

(v) Pipeline:

The water will be pumped to the drill site through 4" aluminium pipe by an Ajax pump powered by a Caterpillar D320 engine.

(vi) Contractor: Horwood Bagshaw Engineering Pty. Ltd.

4. Hole and Casing Programme:

First Phase

(a) Hole:

Diameter:	17-1/2"
Depth:	700 feet.

(b) Casing:

Size:	13-3/8"
Type:	Oilwell - Seamless steel
Weight:	48 #/ft.
Grade:	H-40
Joints:	23
Approx. Setting Depth:	700 feet.

Accessories

Casing Shoe: Type	Howco Guide Shoe
Casing Collar: Type	None
Plugs:	One top plug
Centralizers:	Four Howco S-3

Casing (Cont'd).

Scratchers:	None
Cementing:	Class "A" with 2% HA-5
Sacks:	750 (includes 8' conductor cement)
Expected rise:	To the surface
Equipment:	Cementing will be done by Halliburton Limited using an HT400 pumper and Howco Triplex pumps capable of 10,000 p.s.i. A top plug only will be used. It will be stopped at 600' as measured by displacement volume.

(c) Casing Head Housing:

Make	Model	Flange Size	Working Pressure
OCT	C-22	13-3/8" x 12" 600 series	2,000 p.s.i.

(d) Bits:

Size	Make	Type	Quantity
17-1/2	Reed	YT3A	1

Second Phase:

(a) Hole:

Diameter:	12-1/4"
Depth:	7,000 feet.

(b) Casing:

Size:	9-5/8"
Type:	Oilwell - Seamless steel
Weight:	40 #/ft.; 43.5 #/ft.; 47 #/ft.
Grade:	N-80
Joints:	226
Approx. Setting Depth	7,000 feet
Accessories	
Casing Shoe:	Howco Float Shoe
Casing Collar:	Howco Float Collar
Plugs:	One top plug and one bottom plug
Centralizers:	10 Howco S-3
Cementing:	Class "A" with Howco HR-4
Sacks:	1,000 sacks
Expected rise:	200' above the Mooga
Equipment:	Cementing will be done by Halliburton Limited using an HT400 pumper and Howco Triplex pumps capable of 10,000 p.s.i. Top and bottom plug will be used. Plug will be pumped to float collar positioned 2 joints off bottom.

(c) Casing Head Housing:

Make	Model	Flange Size	Working Pressure
OCT	C-22	12" 600 x 10" 900	3,000 p.s.i.

(d) Bits:

Size	Make	Type	Quantity
12-1/4	Smith	DTSJ	1
		DT2GHJ	2
		K2PHJ	2
		SV2HJ	2
		T2HJ	3
		L4HJ	6
		4W4HJ	2
8-7/16	Christensen	Diamond	2
7-3/4			1

Third Phase:

(a) Hole:

Diameter: 8-1/2"
Depth: 12,000 feet.

(d) Bits:

Size	Make	Type	Quantity
8-1/2	Smith	C4HJ	23
		K2PHJ	2
		T2HJ	3
		4W4HJ	26
		TC8J	4
		TC9J	12
8-7/16	Christensen	Diamond	2
7-3/4			1

5. Details of Rig:

Plant and equipment owned by: Drilling Contractors (Australia) Pty. Ltd.

(a) Draw Works:

Make	National
Type	80B
Rated Capacity	14,000 feet with 4-1/2" drill pipe

(b) Mast/Derrick:

Make	Lee C. Moore
Type	136 feet
Rated Capacity	830,000 lbs.

(c) Rotary Table:

Make	Oilwell
Type	Model 26" H.D.
Size	26" opening

(d) Engines:

Draw works:

Make	Superior
Type	(2) PTDS6 (1) PTD6
H.P.	1,365
Number	3
Total H.P. available to draw works	1,365

Pumps:

Make	Superior	Superior
Type	PTDS6	PTD6
H.P.	945	420
Number	(2)	(1)

(e) Mud Pumps:

Make	National	National
Type	G700	C250
Size	(6"-7-1/4)x14"	7-1/4 x 15"
Number	(2)	(1)

(f) Blow-out Preventor:

Make	Shaffer	Hydril
Model	Double Hydraulic	G.K.
Size	12" 900 series	12" 900 series
Working Pressure	3,000 p.s.i.	3,000 p.s.i.

(g) Drill Pipe:

Size	4-1/2" Spang
Type	4-1/2" F.H.
Weight	16.6 #/ft.
Grade	E
Range	2

(h) Drill Collars:

Diameter	8"	6-3/4"
Bore	3"	2-7/8"
Length	30 feet	30 feet
Number	12	30

(i) Core Barrels:

Make	Christensen 6-3/4" x 4" x 60' double tube core barrel.
Model	Series 250P complete with safety joint and handling tools.
Length	60 feet
Number	(2) Serial numbers: 1407 and 1427

6. Transportation:

(a) Into site (rig to be moved from Moomba field)

	Tons		Miles	
	Road	Air	Road	Air
Rig and Associated Plant	442.0		116	
Casing	154.3		740	
Drill pipe and Drill collars	167.6		116	
Mud materials	102.9		740	
Cement	90.2		740	
Camp, equipment	19.1		740	
etc.	109.9	19.1	116	550

(b) Out from site (rig to be moved to Moomba field)

	Tons		Miles	
	Road	Air	Road	Air
Rig and Associated Plant	442.0		116	
Drill pipe and Drill collars	167.6		116	
Camp, equipment etc.	109.9		116	

7. Mud Programme :

Mud Type: The Kalladeina No. 1 well will be spudded with water containing bentonite for hole stability. The intermediate hole will be drilled to the top of the transition beds with water supplemented with chemicals for viscosity control. At this point, water will be displaced from the hole and replaced with a causticised lignite-ligno sulfonate mud system that will continue to total depth. The mud will weigh approximately 10 lb. per gallon.

The field laboratory contains all the latest API mud testing equipment. The mud will be tested daily and rheological properties will be kept at optimum values by chemical treatments as dictated by the API tests.

Mud Materials	Quantity (Lbs)	Sacks	Tons
Aqua Gel	57,000	570	25.45
Q-Broxin	43,500	870	19.42
CC-16	21,750	435	9.71
Bi-Carbonate of Soda	2,254	24	1.00
Caustic Soda	11,900	85	5.31
Calcium Chloride	3,360	24	1.50
Sodium Chloride	4,930	44	2.20
Barytes	60,300	1,078	26.90
Celloseal	1,457	52	0.65
Magco Fibre	7,900	158	3.53
FE-8	4,500	90	2.00
Con Det	890	2	0.40
Soda Ash	8,580	46	3.83
Sodium Bi-Chromate	2,240	5	1.00
			102.90

8. Ditch Samples:

(a) Ditch Samples will be caught as follows:

(i)	Surface to Transition Zone	30 foot intervals
(ii)	Transition Zone to Total Depth	10 foot intervals
(iii)	While Coring	5 foot intervals
(iv)	While Circulating	15 minute intervals

(b) One set of samples will be washed and retained for use at the wellsite. Bagged samples will be re-washed and divided into required sets at the Company's Warehouse in Adelaide. One set will be forwarded to the Bureau of Mineral Resources with others retained by Delhi Australian Petroleum Ltd. and Santos Limited. The Bureau of Mineral Resources set will be forwarded to:

Geologist-in-Charge
Core and Cuttings Laboratory
8 Isa Street
FYSHWICK CANBERRA A.C.T.

9. Coring:

(a) Coring Programme:

(i) One core will be cut in the Walloon and another in the Hutton Formation for lithology and palaeontology. Another core will be cut after reaching the Lower Palaeozoic for stratigraphic, structural and lithologic information.

Coring Programme (Cont'd)

(ii) In the Lower Palaeozoic, cores will be cut for stratigraphic, structural and reservoir information. The cores will be obtained at convenient bit change depths and as nearly as practicable at intervals of 300 feet.

(iii) Additional cores will be cut to evaluate hydrocarbon shows. If any drill stem test has a good oil recovery or flows gas in significant quantities, the reservoir will be continuously cored until the hydrocarbon bearing interval has been fully penetrated.

(iv) A bottom hole core will be cut.

The specific programme is proposed as follows:

Formation (predicted top)	Number and Length of Cores
Walloon (5,250 feet)	1 x 10 feet
Hutton (5,550 feet)	1 x 10 feet
Lower Paleozoic (6,600 feet)	1 x 10 feet at top plus estimated 16 x 10 feet cores
Total Depth (12,000 feet)	1 x 10 feet

(b) Core Diameters and Length:

Coring will be with diamond coring equipment. The cores will be approximately 4" in diameter. Diameter of conventional cores, if any, will be at least 2-3/8". The length of cores will be 10 feet, except in the case of extremely hard formations, when if the coring rate is very slow, shorter cores will be cut.

(c) Recovery:

A second core will be cut if recovery on the first run is considered to be inadequate by the wellsite geologist.

(d) Sidewall Sampling:

A Schlumberger sidewall sampling gun will be available at the location. Sampling for palynology will be conducted where it will give stratigraphic information not available from the conventional cores programmed. The formations to be sampled and the number of samples to be taken will be decided on the basis of information obtained during drilling.

10. Deviation:

Test runs are to be made at intervals not exceeding 500 feet as drilling proceeds. If there is a sudden change of deviation the previous 500 feet shall be surveyed at 100 foot intervals to determine if a dog-leg exists and the interval between runs is to be reduced to 100 feet until the rate of change returns to within the limits set out below.

Maximum deviation allowable shall be as follows:

Depth Interval	Maximum allowable change in hole angle between two points 500 feet apart
1,000 feet above T.D.	3-3/4 degrees
Next 1,000 feet higher	3-3/4 degrees
Next 1,000 feet higher	2 degrees
Remaining distance to surface	1-1/2 degrees

11. Wellsite Laboratory Services :

(a) Mud Control :

(b) Gas Detection :

(i) Name of Service Company: Exploration Logging of Australia Inc.

(ii) Equipment to be used: Portable Automatic Gas Detector

(iii) Data to be provided: Continuous detection of gas in mud stream

(c) Gas Analysis :

No gas analysis equipment will be available at the wellsite. Gas samples will be collected from drill stem tests with gas shows. The collected samples will be forwarded to The Australian Mineral Development Laboratories for chromatographic analysis.

(d) Penetration Rate :

(i)	Name of Service Company:	Operator owned
(ii)	Equipment to be used:	Geolograph Recorder
(iii)	Data to be provided:	Continuous depth record and rate of penetration graph

(e) Core Analysis :

No core analysis can be conducted at the wellsite with present equipment. As soon as the core is laid down, samples will be collected, sealed and forwarded to Core Laboratories, Brisbane. Core Laboratories will measure core samples for porosity, permeability and water saturation.

(f) Cuttings Analysis :

(i)	Operator:	Delhi Australian Petroleum Ltd.
(ii)	Equipment to be used:	Fully manned and equipped geological laboratory including binocular microscope and standard chemicals.

(g) Fluorescence Detection:

(i)	Operator:	Delhi Australian Petroleum Ltd.
(ii)	Equipment to be used:	Standard fluorescope with an ultra violet light.

(h) Other Services :

No other services will be carried out at the wellsite.

12. Logging and Surveys:

(a) Operator: Schlumberger Seaco Inc.

(b) Equipment:

(i) International Truck Standard
(ii) Gamma Ray - Bore Hole Compensated Sonic Log
(iii) Induction-Electric Log
(iv) Proximity Log - Microlog
(v) Density Log - Caliper
(vi) Continuous Dipmeter
(vii) Laterolog
(viii) Standard Thermometer

(c) Runs:

(i) Run 1

Depth	Tools
500 - 7,000	Gamma Ray - Bore Hole Compensated Sonic Log
500 - 7,000	Induction - Electric Log
500 - 7,000	Density Log
500 - 7,000 Over prospective) zones in 500 -) 7,000 interval)	Continuous Dipmeter Proximity Log

(ii) Run 2

Depth	Tools
7,000 - 9,000	Gamma Ray - Bore Hole Compensated Sonic Log
7,000 - 9,000	Induction-Electric Log

(iii) Run 3

Depth	Tools
9,000 - 11,000	Gamma Ray - Bore Hole Compensated Sonic Log
9,000 - 11,000	Induction-Electric Log

(iv) Run 4

Depth	Tools
11,000 - 12,000	Gamma Ray - Bore Hole Compensated Sonic Log
11,000 - 12,000	Induction-Electric Log
7,000 - 12,000	Density Log - Caliper
7,000 - 12,000	Proximity Log - Microlog
7,000 - 12,000	Laterolog
7,000 - 12,000	Continuous Dipmeter

Notes to Logging and Surveys

(a) A casing collar locator will be run if production casing is set.

(b) A Velocity Survey will be run in conjunction with a Seismic Contractor at total depth.

(c) The standard thermometer will be included in all runs.

13. Formation Testing:

(a) Programme:

All shows of oil or gas will be drill stem tested as soon as detected. Where a section with porosity but without shows is drilled, a drill stem test may be run to provide reservoir data or to eliminate any doubt as to hydrocarbon content. In doubtful situations, tests will be conducted.

(b) Equipment:

Packers:	Howco No. 3 Conventional
Testers:	Howco 5" Hydrospring
Closed-in Pressure Valves:	Howco 5" Dual
B.H.P. Recorders:	Howco 0-10,000 Bourdon Tube
B.H.P. Clocks:	Howco 2-12 hour rotating
Flow Measurement:	Oil Direct and chokes Gas Daniel Orifice meter
Separator:	National Tank, skid mounted, 3MGO-1016-10

14. Abandonment:

In the event the well is a dry hole, it will be plugged according to the South Australian Mines Department plugging procedures.

15. Personnel:

(a) Shifts to be run:

Daily	3
Weekly	21
Hours per shift	8

(b) Drilling Crew:

Toolpusher	1
Catheadmen	3
Assistant Toolpusher	1
Rig Mechanic	1
Drillers	3
Rotary Helpers	9
Derrickmen	3

(c) Other on-site Labour:

Cooks	3
Handymen and others	15

(d) Administration, etc.:

Drilling Foreman and Mud Engineer	C.T. Skov
Wellsite Geologist	N. Papalia, alt. O. Nugent
Petroleum Engineer	E.F. Spinks

(e) Accommodation:

The camp, presently located in the Moomba field, will be moved to a point near the Kalladeina No. 1 location. The camp is completely air conditioned and can house 77 personnel. The camp will be supplied with 240 volt electric power and bottled gas for cooking and hot water service.

16. Transport:

Furnished by Operator for supervisory and operating personnel:

2 Landrovers	4 x 4	
4 Nissan	4 x 4	
1 Toyota	4 x 4	
1 Chevrolet	4 x 4	
2 Leyland Comets	4 x 4	
1 Mack Truck	6 x 6	complete with winch and gin poles

Furnished by Contractor:

1 Landrover
3 Oilfield trucks complete with winch and gin poles

One DC3, one Cessna 310, Cessna 206's and 210's and other aircraft as required under charter will serve the site from Adelaide.

Delhi Australian Petroleum Ltd.
Santos Limited

Kalladeina No. 1
Attachment No. 2
Revised April 26, 1967

KALLADEINA #1

(a)	Access				25,000
(b)	Site Prep.				1,000
(c)	Water Supply				8,000
(d)	Transport				
	(i)	Equip. in			24,500
	(ii)	Consumable			27,100
	(iii)	Equip. out			8,350
(e)	Consumable mat. cost				
	(i)	Bits			37,619
	(ii)	Coreheads and core barrels			10,500
	(iii)	Fuel			24,000
	(iv)	Casing	1. Conductor	94	
			2. First String	3,386	
			3. Second String	37,436	40,916
	(v)	Cement			1,815
	(vi)	Drilling Fluids			17,230
	(vii)	Mix and spare			2,100
(f)	Rental				38,400
(g)	Rig Rental				
	(i)	Rig up and down	21 days @ $490		10,280
	(ii)	Drilling	64 days @ $1500		96,000
	(iii)	Coring and testing	24 days @ $1500		36,000
	(iv)	Cementing, etc.	7 days @ $1358		9,510
	(v)	Logging	4 days @ $1188		4,760

Delhi Australian Petroleum Ltd.
Santos Limited

Kalladeina No. 1
Attachment No. 2
Revised April 26, 1967
Page 2.

(h)	Special Service Costs		
	(i)	Logging	56,300
	(ii)	Formation Testing	9,000
	(iii)	Cementing	2,000
	(iv)	Mud Logging	2,440
	(v)	Other (Howco Contract Rental, copy attached)	15,820
(i)	Salaries and Wages		
	(i)	In attendance	18,000
	(ii)	Directly engaged	2,000
(j)	General		
	(i)	Communications	450
	(ii)	Insurance	1,000
	(iii)	Data Reproduction	2,800
		Total "A"	532,890

Delhi Australian Petroleum Ltd.
Santos Limited

Kalladeina No. 1
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Page 3.

	Original Cost	Estimated Period (Weeks)	Rate of Depreciation	Amount of Depreciation
Machinery and Camp Equipment	88,112	17.15	10%	2,905
Surface drilling plant and downhole equipment	419,176	17.15	20%	27,660
			Total "B"	30,565
		Total "A" and "B"		563,455

Table I

Minimum Daily Mud Treatments include the following:

Aqua Gel	570# per day
Q-Broxin	500# per day
CC-16	250# per day
Caustic Soda	120# per day

Table II

DRILLING TIME ANALYSIS

Information	Gidgealpa #1	Merrimelia #2	Kalladeina #1
Drilling time from surface through Intermediate casing point	6340' in 13 days	7207' in 19 days	7000' in 16 days
Days drilling the Cambrian	3890' in 52 days	4422' in 85 days	
Average penetration rate drilling the Cambrian	75' per day	52' per day	
Estimate to drill 5000' of Cambrian	96 days	67 days	Average 81 days
Estimate 3 additional days logging and plugging			

Delhi Australian Petroleum Ltd.
Santos Limited

Kalladeina No. 1
Attachment No. 2
Revised April 26, 1967
Page 6.

Table III

SURFACE DRILLING PLANT, DOWNHOLE EQUIPMENT AND CAMP

	$A
Casing Racks	946
Substitutes Reamers and Stabilizers	9,515
Fishing Tools	28,913
Dog House and Equipment	950
Drill Collars - 11 x 6"	7,956
Drilling and Production Equipment General	18,743
Gas Separator, Spares and Tank	7,441
Gas Heater	3,139
Production Trailers Units 54, 68, 69, 71 and 72	5,351
Christensen Core Barrels and Spares	12,940
Warehouse Buildings	6,134
Hand Tools and Miscellaneous Equipment	7,354
Camp Equipment including electrical wiring and spares, amenities, etc.	19,422
Electrical Generating Sets (2 Caterpillar D333 with 75 KUA 1 - Caterpillar D13,000 with 100 KUA)	19,150
Vehicle Spares	3,198
Geological and Mud Engineering Units 32 and 47	18,376
Mechanic and Electrician vans, Units 33 and 34	6,111
40' x 10' - 10 Man Bunkhouse Trailer, Mobile Units 19, 20, 22	20,850
40' x 10' - 10 Man Bunkhouse Trailer, Skid mounted, Units 39-44 and 45	21,922
40' x 10' - 6 Man Bunkhouse Trailer, Mobile, Unit 23	6,950
40' x 10' - 6 Man Bunkhouse Trailer, Skid mounted, Unit 46	5,636
40' x 10' - Bunkhouse Office First Aid Trailer, Mobile, Unit 21	8,165
40' x 10' Bunkhouse Office, Mobile, Unit 24	6,983
40' x 10' Kitchen and Coolroom, Mobile, Unit 25	18,414
40' x 10' Diner Storage, Mobile, Unit 26	6,530
40' x 10' Diner Canteen, Mobile, Unit 27	8,270
40' x 10' Washcar Laundry toilet, Mobile, Unit 28	9,563

Table III (cont'd)

Kitchen Van Mobile, Unit 35 (Road Gang)	3,833
Camp dry goods storage Pantechnican Unit 37	2,356
26,000' 4" Victaulic water line	19,618
33,000' 4" Aluminium water line	19,983
2 - 4 x 4 Leyland Comet Trucks	26,316
1 - 4 x 4 Chevrolet Blitz water tanker	2,200
4 Nissan Patrol 4 wheel drive vehicles	12,983
2 Landrover 4 wheel drive vehicles	9,047
1 Toyota Land Cruiser 4 wheel drive vehicle	3,150
Mack Ginpole Truck	30,768
	419,176

Delhi Australian Petroleum Ltd.
Santos Limited

Kalladeina No. 1
Attachment No. 2
Revised April 26, 1967
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Table IV

MACHINERY AND EQUIPMENT

	$A
One Caterpillar 12E Grader	24,618
One Caterpillar 922 Front End Loader	17,858
One Caterpillar D6C Dozer	30,660
One Ajax multi-stage centrifugal Pump powered by a Caterpillar D320 Engine	5,044
3 Horwood Bagshaw 503 Balanced Beam Pump Jacks powered by Lister SL2 Diesels	3,707
2 Finsbury 2" Medium water pumps	388
1 Finsbury 2" Heavy duty water pump	348
1 Kelly & Lewis 2" x 2-1/2" Centrifugal water pump powered by 2 cyl. Dentz Diesel engine	3,708
One Ajax 2K BSP std 2" x 2-1/2" centrifugal water pump powered by Wisconsin petrol motor	394
Air Compressor	342
Electric Welder	1,045
	88,112

2 copies
EFS

RESEARCH FOR INDUSTRY

Table V

071

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

CONYNGHAM STREET · PARKSIDE · SOUTH AUSTRALIA
TELEPHONE 791662 · TELEGRAMS 'AMDEL' ADELAIDE

Please quote this reference in your reply:

AN3/51/0-2128/67

28th March, 1967

Your reference: Exploration Manager,
Delhi Australian Petroleum Ltd,
GPO Box 1837P,
ADELAIDE.

O/N 19556A
Req. No. 8740

	PARTS PER MILLION
Chloride, Cl	21340
Sulphate, SO_4	4523
Bicarbonate, HCO_3	135
Nitrate, NO_3	present
Sodium, Na	13420
Potassium, K	-
Calcium, Ca	1063
Magnesium, Mg	750
Silica, SiO_2	-
Iron, Fe	-
pH	-
Total	41231
Suspended matter	
Organic matter	

ASSUMED COMPOSITION OF SALTS	PARTS PER MILLION
Calcium bicarbonate	179
Calcium sulphate	3462
Calcium chloride	-
Magnesium bicarbonate	-
Magnesium sulphate	2607
Magnesium chloride	873
Sodium bicarbonate	-
Sodium sulphate	-
Sodium chloride	34110
Sodium nitrate	
Potassium chloride	
Iron Bicarbonate	

HARDNESS (as Calcium Carbonate)	PARTS PER MILLION
Total	5740
Temporary	110
Permanent	5630
Due to calcium	2654
Due to magnesium	3086
Due to iron	

Prospect: AFE A-P-Ex-1-67
Kalladeina No. 1

NAME

Hole No. 1

Water Cut

Address

Water Level

Supply

Hundred

Depth Hole

Section

Date Collected

Sample collected by

P. A. YOUNG
Director.

AGREEMENT

THIS AGREEMENT, made and entered into this 21st day of March, 1967, by and between HALLIBURTON LIMITED, a company limited by shares, incorporated under the Companies Act of 1948 of England, with principal offices at 23-25 Maddox Street, London W. 1., England, hereinafter referred to as "HALLIBURTON," and DELHI AUSTRALIAN PETROLEUM LTD., with its principal office and place of business at 32 Grenfell Street, Adelaide, South Australia, hereinafter referred to as "CUSTOMER."

NOW, THEREFORE, for and in consideration of the mutual promises and agreements of the parties hereto, the parties hereby agree as follows:

I

1.01 As used in this agreement, the term "area of operations" shall mean the States of Australia.

1.02 HALLIBURTON agrees to lease to CUSTOMER for use in the area of operations the equipment listed in attached Schedule A.

1.03 HALLIBURTON will deliver such equipment to CUSTOMER at designated port in Australia. All costs incurred in shipping such equipment from Duncan, Oklahoma, to Australia will be at the expense of HALLIBURTON. As used herein, shipping costs shall include, but not be limited to, all expense of inland transportation to port of exit, ocean freight, wharfage and harbor fees, charges and duties, and cost of loading and unloading, crating and packaging.

II

2.01 HALLIBURTON will establish one combination service operator based in Australia assigned to perform services for CUSTOMER in Australia using the equipment furnished under paragraph 1.02 by HALLIBURTON to CUSTOMER.

2.02 HALLIBURTON shall comply with all laws and ordinances of the country of origin and the area of operations relating to the employment and welfare of the service operator, including workers' compensation obligation of HALLIBURTON in the various States of Australia, and his entrance into and exit from the country and any transit countries.

2.03 In the event the service operator is unable to reach the drilling site using available HALLIBURTON owned transportation, CUSTOMER shall, at its expense, furnish transportation to and from the drilling site for such service operator.

2.04 CUSTOMER shall have the right for good cause to request the removal of any HALLIBURTON service operator, either for technical incompetency or misbehavior. HALLIBURTON agrees to observe any such request at its own cost and to replace such service operator at HALLIBURTON'S expense.

2.05 CUSTOMER, at its expense, agrees to make available to HALLIBURTON'S service operator, when present at the drilling site at CUSTOMER'S request, housing, sustenance, and medical assistance of the same type and class as CUSTOMER furnishes at the work site to its own employees of similar classification under similar conditions.

2.06 If the service operator is required by CUSTOMER to be at the well site more than twenty-one (21) days in any one (1) month, HALLIBURTON shall be paid, in addition to the other payments required herein, the sum of One Hundred and No/100 Dollars ($100.00) for each day at the well site in excess of twenty-one (21).

III

3.01 CUSTOMER agrees to pay HALLIBURTON as rental for the use of the equipment furnished under Schedule A and for services performed by the service operator furnished by HALLIBURTON an amount equal to the total of the service charges for service operations performed with such equipment in accordance with the attached Service Price Schedule.

3.02 Payments provided herein shall commence as of the date that CUSTOMER'S well in the area of operations is spudded in and shall, continue until this agreement is terminated as herein provided.

3.03 HALLIBURTON will maintain said equipment in good repair during the term of this agreement, subject to paragraph 4.05, with repair parts being supplied by HALLIBURTON, at its expense. CUSTOMER will provide all fuel and lubricants required for said equipment.

IV

4.01 CUSTOMER agrees that the equipment leased will be used only on the wells being drilled by CUSTOMER in the area of operations, and CUSTOMER will not permit any person to operate the equipment other than the service operators furnished under this agreement.

4.02 It is mutually agreed and understood that the service operators furnished under this agreement to CUSTOMER shall, during the performance of oil well service operations for CUSTOMER, be under the sole direction, supervision and control of CUSTOMER with no right of direction, supervision and control remaining in HALLIBURTON, and HALLIBURTON shall not be liable for any loss, damage or injury to any of the wells or property of CUSTOMER resulting from the use of the equipment leased or the acts or omissions of the service operators or of any other person.

4.03 CUSTOMER agrees to indemnify and protect HALLIBURTON against any and all claims for injury, loss or damage, including but not limited to property damage, personal injury or death, suffered by CUSTOMER, its agents or employees, or by third persons caused by any act or omission of HALLIBURTON or its employees arisin g out of or in any way connected with the equipment furnished or services performed.

4.04 In case it should become necessary for CUSTOMER to "fish" for any of the instruments of equipment furnished under this agreement, CUSTOMER assumes the entire responsibility for such fishing operations. The service operators furnished under this agreement are not authorized to do anything in fishing operations other than advise and consult with CUSTOMER. Advice or assistance or any fishing tools furnished which might be furnished by HALLIBURTON will be provided solely as an accommodation to CUSTOMER and HALLIBURTON shall not be liable or responsible for any damage that CUSTOMER may incur or sustain, even though such might be due to an act or omission of HALLIBURTON or its employees.

4.05 In the event that the equipment or any part thereof should be damaged or destroyed by the willful or negligent acts or omissions of CUSTOMER, but not service operators, CUSTOMER agrees to be responsible for and pay for such repair or replacement at HALLIBURTON'S replacement cost.

V

5.01 Payment of the charges provided in this agreement shall be made by CUSTOMER to HALLIBURTON within twenty days after receiving an invoice. Interest at seven (7) per cent per annum will be charged on invoices not paid after sixty days from the date of invoice. All prices are exclusive of any excise, sales or use taxes, or taxes of a similar nature, which may lawfully be imposed on the furnishing of equipment and services. The amount of any such taxes for which HALLIBURTON may be legally liable shall be added to the payments required to be made by CUSTOMER, subject to CUSTOMER'S right to verify that the taxes are in fact duly paid. Provided, however, HALLIBURTON agrees to pay any tax or assessment upon its service operations covered by this contract based upon or measured by income imposed or levied by the Government of the United States or the Government of Australia, or any subdivision thereof.

5.02 Tickets covering each service operation performed will be made out on regular HALLIBURTON forms, which will be returned to HALLIBURTON at London, England, and invoices covering all such service charges will be made by HALLIBURTON and forwarded to CUSTOMER at 32 Grenfell Street, Adelaide, South Australia, for payment. CUSTOMER agrees to pay HALLIBURTON in Australian currency at Melbourne, Australia, at the then existing official rate of exchange between Australian currency and United States currency. In the event that any tickets, purchase orders, or other documents of either CUSTOMER or HALLIBURTON contain any terms or provisions inconsistent or in conflict with any of the terms of this agreement, it is mutually agreed that the terms and provisions of this agreement shall control and the terms and provisions of such tickets, purchase orders or other documents shall be wholly void insofar as they are inconsistent or in conflict herewith.

VI

6.01 This agreement shall be for a minimum term of three months from the date CUSTOMER'S well in the area of operations is spudded in, and thereafter shall extend from month to month, provided that during any such extension, both HALLIBURTON and CUSTOMER shall have the right to terminate this agreement upon giving thirty days' written notice to the other party.

6.02 Neither party to this agreement shall be liable for failure to perform the terms of this agreement when performance is prevented by "force majeure," which shall be defined as labor disturbances, riots, war, military action, action of the elements, acts of God, insurrection, fire, acts of any governmental or military agency acting under actual or assumed authority, or any cause beyond the control of either party, whether or not similar to matters herein specifically enumerated. This shall not be considered, however, as relieving CUSTOMER of its obligations under paragraph 4.05.

VII

7.01 This agreement embodies all the terms and conditions agreed upon between the parties. None of the requirements and obligations of this agreement shall be considered as waived by either party unless done so in writing and then only by an instrument executed on behalf of the parties by a corporate officer.

7.02 Notices shall be deemed given when placed in the regular course of registered air mail, postage prepaid, addressed to HALLIBURTON at 23-25 Maddox Street, London W.1, England, and to CUSTOMER at 32 Grenfell Street, Adelaide, South Australia.

7.03 This agreement shall be regarded as a South Australian contract and the rights and obligations hereunder shall be so construed and in-terpreted.

7.04 This agreement and the equipment furnished hereunder may not be assigned or sublet in part or in whole by either party hereto without the prior written consent of the other, except that it may be assigned by HALLIBURTON to its parent company or to one of its subsidiary companies.

IN WITNESS WHEREOF, the parties hereto have executed this agreement in duplicate effective as of the day and year first above written.

ATTEST: HALLIBURTON LIMITED

_____ By _____
Managing Director

ATTEST: DELHI AUSTRALIAN PETROLEUM LTD.

By _____
Resident Manager

SCHEDULE A

SERVICING CHARGE

1	HT 400 Cementing Truck powered with V871 GM Engines	$3700.00
1	3-1/2 IF CB High Pressure control head with wrap around manifold	194.00
1	5-1/2" Single plug container cement head and manifold	48.00
1	7" Single plug container cement head and manifold	53.00
1	9-5/8" Single plug container cement head and manifold	58.00
1	13-3/8" Single plug container cement head and manifold	60.00
2	BT Clock - 12 hour	50.00
2	BT pressure recorders 6,000 psi $100.00	200.00
1	5" Dual closed in pressure valve	84.00
1	5" Hydrospring tester	80.00
1	5" AP BT running case	22.00
1	5" Halliburton Jar	37.00
1	No. 3 expanding shoe packer assembly equipped for 8-1/2" + 12-1/4" hole	100.00
1	5" VR Safety Joint	36.00
1	5" Blanked off BT anchor shoe case	25.00
1	5" Set perforating anchor	71.00
1	5" H90 impact circulatong sub	12.00
1	Thermometer case and 2 thermometers	6.00
4	1-1/2" Chicksan steel testing flow hose	48.00

Subs.

1	3-1/2 IF Box x 4-1/2 FH Pin	15.00
1	3-1/2 IF Pin x 4-1/2 FH Box	15.00
1	Combination operator 0-21 days	2000.00
		$6,914.00

The Australian
Mineral Development
Laboratories

lemington Street, Frewville,
South Australia 5063
Phone Adelaide 79 1662
Telex AA 82520

Please address all
correspondence to
P.O. Box 114 Eastwood
SA 5063
In reply quote:

amdel

28 June 1983

F4/454/2/0
6188/83 - Part 1

South Australian Oil & Gas Corp. Pty. Ltd.,
PO Box 470,
NORTH ADELAIDE SA 5006

Attention: Mr J. Ponniah

REPORT F6188/83 - Part 1

YOUR REFERENCE:	Purchase Order No.3906
MATERIAL:	Cuttings
LOCALITY:	KALLADEINA No.1
IDENTIFICATION:	Depth interval 11,000-11,250 ft
DATE RECEIVED:	2 June, 1983
WORK REQUIRED:	Total organic carbon, Rock-Eval pyrolysis, Interpretation.

Investigation and Report by: Dr David McKirdy and Dr Robert E. Cox

Chief - Fuel Section: Dr Brian G. Steveson
Manager, Mineral and Materials Sciences Division: Dr William G. Spenc

for Dr Brian Hickman
Managing Director

cah

Head Office:
Flemington Street, Frewville
South Australia 5063,
Telephone (08) 79 1662
Telex: Amdel AA82520
Pilot Plant:
Osman Place
Thebarton, S.A.
Telephone (08) 43 8053
Branch Laboratories:
Melbourne, Vic.
Telephone (03) 645 3093
Perth, W.A.
Telephone (09) 325 7311
Townsville
Queensland 4814
Telephone (077) 75 1377

1. INTRODUCTION

A preliminary organic geochemical study of the Kalladeina Formation in the Warburton Basin (McKirdy and Cox, 1983) revealed that calcareous shale from 11,140 feet depth in Kalladeina-1 contained a moderate concentration (0.63% TOC) of oil-prone organic matter. Accordingly, the interval 11,000-11,250 feet in this well was sampled in more detail for geochemical analysis (Table 1), in order to evaluate the hydrocarbon source potential of the basal shale facies of the Kalladeina Formation (corresponding to Time Interval 2, Ordian : Cook, 1982).

2. ANALYTICAL PROCEDURE

2.1 Sample Preparation

The rock sample (as received) was ground in a Siebtechnik mill for 20-30 secs.

2.2 Total Organic Carbon (TOC)

Total organic carbon was determined by digestion of a known weight (2-10 g) of powdered rock in 50% HCl to remove carbonates, followed by combustion in oxygen in the induction furnace of a Leco IR-12 Carbon Determinator and measurement of the resultant CO_2 by infra-red detection.

2.3 Rock-Eval Analysis

A 100 mg portion of powdered rock was analysed by the Rock-Eval pyrolysis technique (Girdel IFP-Fina Mark 2 instrument; operating model, Cycle 1).

3. RESULTS

TOC and Rock-Eval data on the six additional shale samples from Kalladeina-1 are summarised in Table 2. Selected parameters of maturity (T_{max}, production index), source richness (TOC, potential yield) and kerogen type (hydrogen index) are plotted against depth in Figures 1A and 1B. Figure 2 illustrates the type and maturity of the samples for which realistic T_{max} values were obtained. Note: these figures incorporate the data previously reported for this well (McKirdy and Cox, 1983).

4. DISCUSSION

4.1 Source Richness

The TOC values given in Table 2 confirm that the interval 11,000-11,500 feet has a significantly higher mean total organic carbon content (TOC = 0.38%, n = 9) than does the rest of the Kalladeina Formation in the Kalladeina-1 well (TOC = 0.16%, n = 20).

Three of the shales from this interval contain more than 0.5% TOC and have potential hydrocarbon yields in the range $S_1 + S_2$ = 2.7-4.8 kg/tonne (Fig. 1A). These Ordian shales possess fair source richness. It is of interest that Cook (1982, p.59) recognises the Ordian (his TI 2) as a time of 'nutrient-rich high-productivity conditions' which resulted in 'very shallow marine sediments especially rich in organic matter'.

4.2 Source Quality and Kerogen Type

The three aforementioned shales are also characterised by moderately high hydrogen indices (HI = 357-478: Fig.1A) which demonstrate the presence of oil-prone Type II-III kerogen (Fig. 2).

4.3 Maturity

T_{max} values obtained from the shales examined in this study (Table 2), and the previously analysed samples from 11,140 and 11,331 feet depth (McKirdy and Cox, 1983, table 4), are consistent in indicating a lack of thermal maturity for the lower Kalladeina Formation at this well locality. Equivalent vitrinite reflectances of VR $\leq$ 0.5% are implied.

However, this apparent immaturity is difficult to reconcile with production index values in the range PI = 0.25-0.46 (Table 2, Fig. 1B) which are more characteristic of the upper oil window. It is also at odds with the regional maturity of the overlying Mesozoic rocks (see McKirdy and Cox, 1983, fig.5).

In Cambrian rocks such as these which lack true vitrinite, plotting of kerogen H/C and O/C atomic ratios on a Van Krevelen diagram provides the least equivocal means of establishing absolute organic maturity.

5. CONCLUSIONS AND RECOMMENDATIONS

1. Middle Cambrian calcareous shales from 11,000-11,500 feet depth in Kalladeina-1 are more than twice as organic-rich (TOC = 0.19-0.69%, mean = 0.38%) as the rest of the Kalladeina Formation. The three richest cuttings samples contain Type II-III kerogen and represent potential oil-source beds of fair quality.

2. Although probably not over-mature, the true thermal maturity of these shales remains uncertain. It is therefore recommended that kerogen isolation and full elemental analysis (C, H, N, O, S, pyritic Fe, ash) be undertaken on the three most organic-rich samples (viz. from 11,000, 11,140 and 11,160 feet depth).

3. A palaeogeographic reconstruction (cf. Cook, 1982) of the Warburton Basin for the Ordian time interval is required in order to predict the lateral extent of the basal marine organic-rich shales identified in Kalladeina-1. In this manner it may also be possible to define areas, presumably closer to the basin depocentre, where both organic-richness and maturity are at their optimum for oil-generation.

6. REFERENCES CITED

COOK, P.J., 1982. The Cambrian palaeogeography of Australia and opportunities for petroleum exploration. *APEA J.*, 22(1), 42-64.

McKIRDY, D.M., and COX, R.E., 1983. Preliminary source-rock analysis of the Middle Cambrian Kalladeina Formation in Coongie No.1 and Kalladeina No.1, Warburton Basin, S.A. AMDEL Report No.F5888/83 for South Australian Oil and Gas Corpn. Pty. Ltd.

TABLE 1

KALLADEINA-1: Samples for source-rock analysis

Depth	Sample Type	Description
11000'	Cuttings	Shale
11050'	Cuttings	Calcareous shale
11100'	Cuttings	Calcareous shale
11160'	Cuttings	Calcareous shale
11190'	Cuttings	Calcareous shale
11250'	Cuttings	Shale

TABLE 2

AMDEL

ROCK-EVAL PYROLYSIS

06/06/83

Client SAOGC

Well KALLADEINA #1

DEPTH	T MAX	S1	S2	S3	PI	S2/S3	PC	TOC	HI	OI
11000.00	428	1.49	3.30	0.87	0.31	3.79	0.39	0.69	478	126
11050.00	407	0.13	0.15	0.64	0.46	0.23	0.02	0.29	52	221
11100.00	417	0.24	0.72	0.82	0.25	0.87	0.08	0.29	248	283
11160.00	413	0.78	1.96	1.18	0.28	1.66	0.22	0.52	377	227
11190.00	410	0.13	0.32	1.05	0.30	0.30	0.03	0.26	123	404
11250.00	422	0.04	0.07	0.22	0.40	0.31	0.00	0.19	37	116

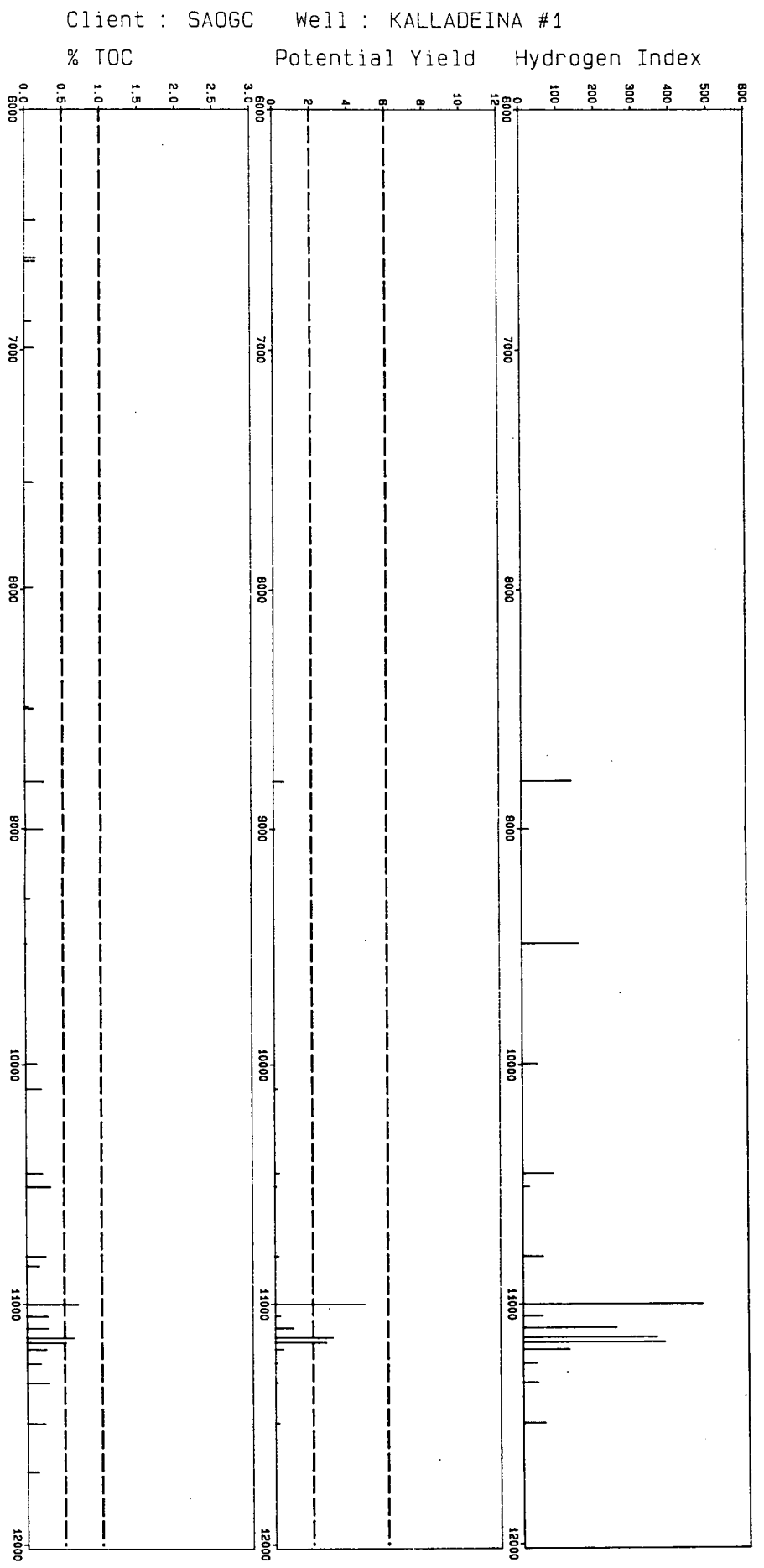
Client : SAOGC Well : KALLADEINA #1
% TOC
Potential Yield
Hydrogen Index
Depth (feet)

FIGURE 1A

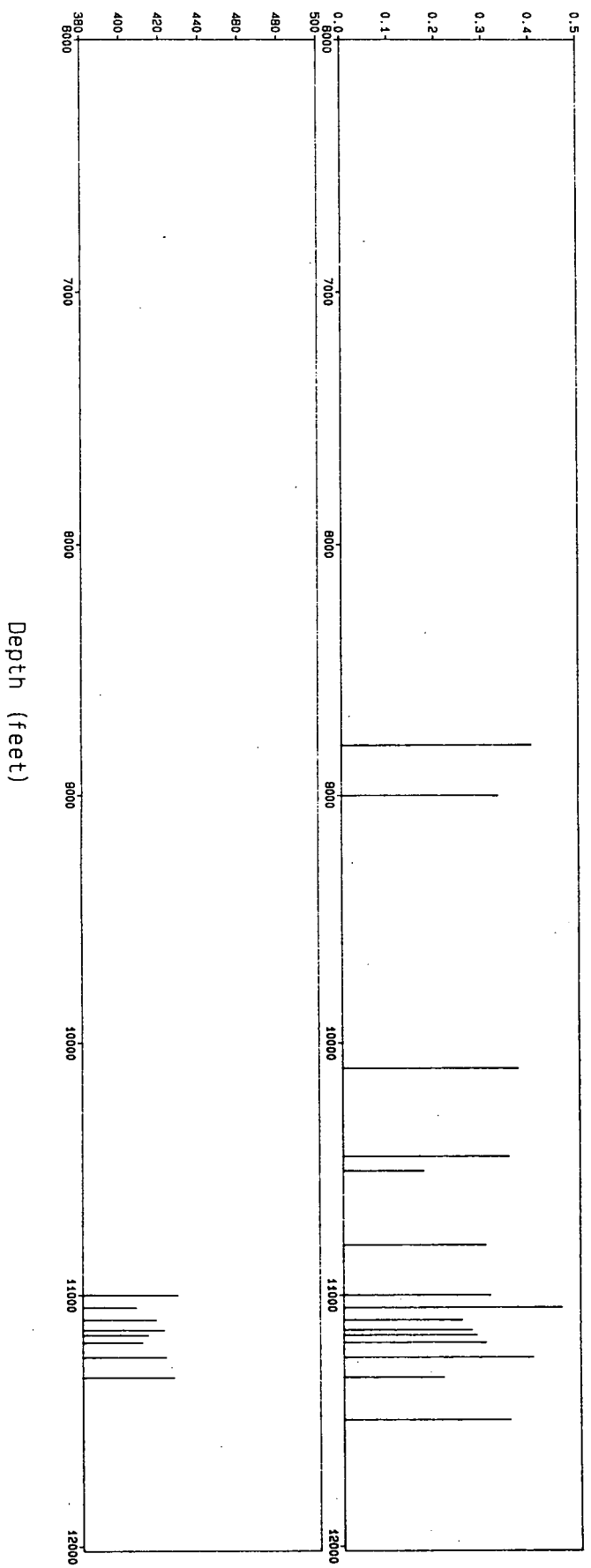
Client : SAOGC Well : KALLADEINA #1
Tmax (°C)
Production Index
380
400
420
440
460
480
500
0.0
0.1
0.2
0.3
0.4
0.5
6000
7000
8000
9000
10000
11000
12000
Depth (feet)

FIGURE 1B

Client : SAOGC
Well : KALLADEINA #1
Interval : KALLADEINA FORMATION

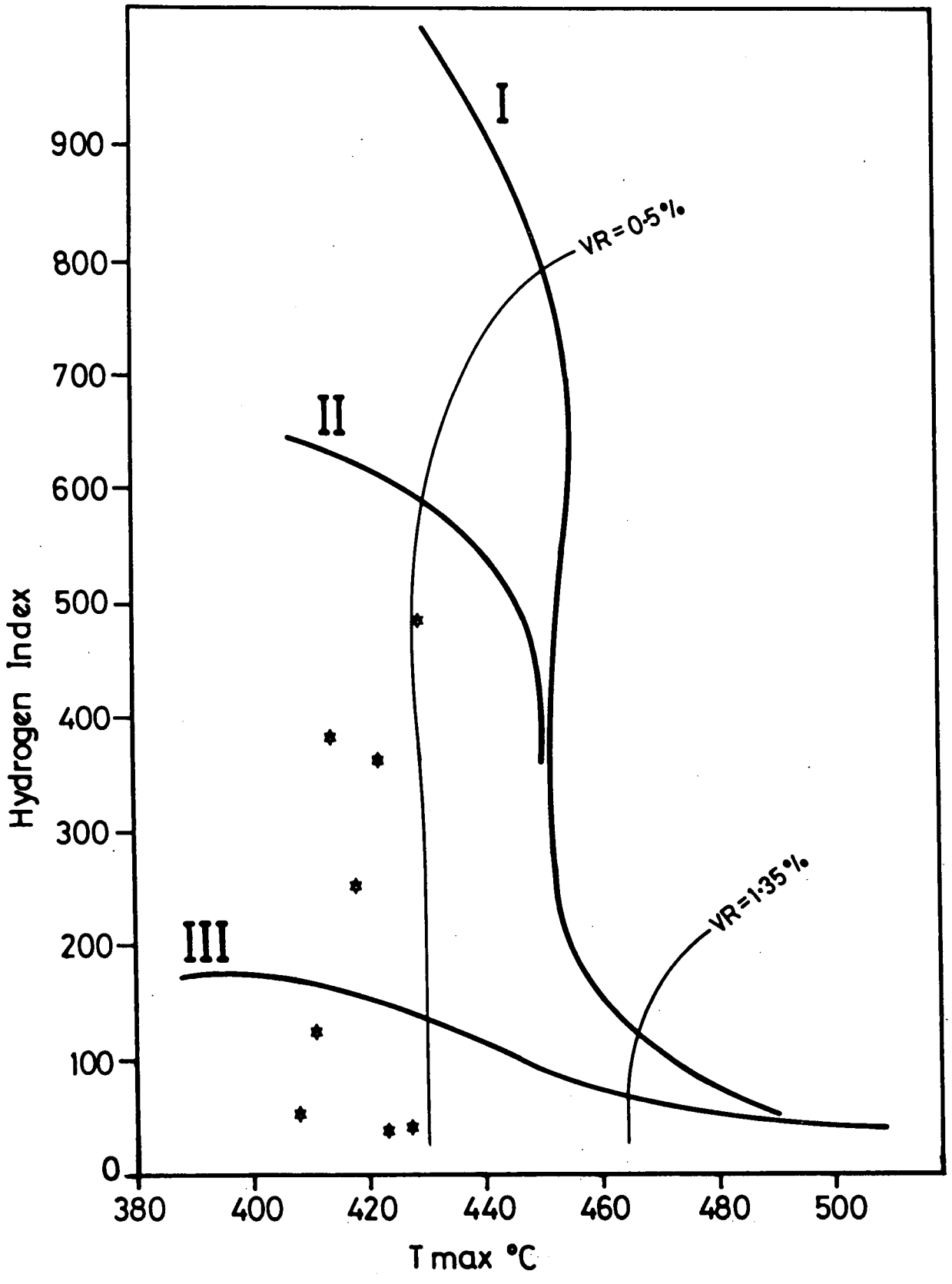

FIGURE 2

KEY TO ROCK-EVAL PYROLYSIS DATA SHEET

	PARAMETER	SPECIFICITY
T max	position of S_2 peak in temperature program (^oC)	Maturity/Kerogen type
S_1	kg hydrocarbons (extractable)/tonne rock	Kerogen type/Maturity/Migrated oil
S_2	kg hydrocarbons (kerogen pyrolysate)/tonne rock	Kerogen type/Maturity
S_3	kg CO_2 (organic)/tonne rock	Kerogen type/Maturity *
$S_1 + S_2$	Potential Yield	Organic richness/Kerogen type
PI	Production Index ($S_1/S_1 + S_2$)	Maturity/Migrated Oil
PC	Pyrolysable Carbon (wt. percent)	Organic richness/Kerogen type/Maturity
TOC	Total Organic Carbon (wt. percent)	Organic richness
HI	Hydrogen Index (mg h'c (S_2)/g TOC)	Kerogen type/Maturity
OI	Oxygen Index (mg CO_2(S_3)/g TOC)	Kerogen type/Maturity *

*Also subject to interference by CO_2 from decomposition of carbonate minerals.