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OPERATIONS REPORT

COLSON SEISMIC SURVEY

OP 238, PEDIRKA BASIN, N.T.

SYDNEY OIL COMPANY (PEDIRKA) PTY LIMITED

OPERATIONS REPORT

COLSON SEISMIC SURVEY
JANUARY - FEBRUARY 1985

OP 238, PEDIRKA BASIN, N.T.

PREPARED BY: J. Douglass
Douglass Exploration

May, 1985

1985/13

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INTRODUCTION

Sydney Oil Company (Pedirka) Pty Limited on behalf of the OP 238 Joint Venture contracted Geosource-Petty Ray Geophysical of Brisbane to conduct the 254km 1985 Colson weight drop seismic survey.

Petty Ray Geophysical subcontracted M.E.S. Pty Limited of Perth to clear line, and provided their own personnel and equipment to drill upholes. Sydney Oil sub-contracted Stewart Gale of Perth to provide crew supervision. Data processing was contracted to Hosking Geophysical of Perth.

After scouting and permitting, line clearing commenced on January 3. Surveying commenced on January 4 and uphole drilling on January 15.

After parameter evaluation tests, production recording commenced on January 12 and concluded on February 15.

LOCATION

The Colson Seismic Survey was located in the south eastern part of the Northern Territory between latitudes 25° 40' and 26° 00' south and longitudes 136° 25' and 137° 00' east.

The town of Alice Springs is located approximately 360 air kms to the north west of the survey area.

Geologically, the survey was located in the Pedirka Basin, and within permit OP 238.

ACCESS, CAMPS, WATER, LOGISTICS, AND COMMUNICATIONS

ACCESS

The dirt road from Oodnadatta, S.A., leading north east to Purni Bore, and then east along the rig road connecting Purni # 1, Mokan # 1 and Macumba # 1 was the prime access to the permit area. At a point approximately 15kms short of Macumba # 1 the access then followed an old track for approximately 45kms to the NNW to Colson # 1, which was located on line 6 in the southern part of the survey area.

Thus the route between Oodnadatta (the supply base) and the first and only camp (at Colson # 1) consisted of approximately 280 kms of fair to poor dirt road.

The 45km section of access between the Colson turn-off and camp was a problem initially for the supply and water vehicles. Sydney Oil agreed to some road building on this section but quickly terminated what could have been a never ending exercise. Once the driver's had learnt how to handle sand and had reduced tyre pressures, the problem diminished.

Coober Pedy, 200km south west of Oodnadatta, was also used for supplies by the crew.

The road access to the permit area from Alice Springs (the nearest jet airport) followed the approximate route of the old Alice Springs-Adelaide railway to Finke and then south east to Mount Dare and Purni # 1. This access of approximately 550kms from Alice Springs to camp was not used by the crew. However, air access for the crew was predominantly with Alice Springs.

Access within the programme area was solely along the new lines and consequently was difficult to the vehicles which in the main were poorly equipped for the terrain.

Line 9 was the only access between the south west and north east grids and although an extra effort was made by the line clearer, it was a very difficult access for the poorly equipped vehicles.

CAMPS

One campsite only was established and that was at Colson # 1 on line 6:

Latitude	25°	57' south
Longitude	136°	40' east

An attempt was made to establish a second campsite for the north east grid work but the camp trailers could not progress along the access line 9 primarily because of their small wheels equipped with road tyres.

WATER

Drinking water was trucked from Coober Pedy and Oodnadatta. The potability of water from Purni is fair and from Mocumba is poor. Water from Colson is quite salty and unsuitable for drinking or camp use.

Since the drill had insufficient stem to attempt a water bore in the programme area, the drilling and camp water was trucked from Macumba which was 65kms south from camp.

Delhi Petroleum agreed to the use of this water and an air compressor from Oodnadatta lifted about 8000 gallons per hour from a depth of approximately 90 feet.

The location of the bore is approximately:

Latitude	26°	28' south
Longitude	136°	52' east

LOGISTICS

Food Supplies

Stores were purchased and picked up in Oodnadatta and Coober Pedy by the supply truck. Some fresh foods were despatched from Alice Springs on the weekly air charter. This arrangement worked fairly well.

Fuel Supplies

Diesel fuel was trucked from Oodnadatta most of the way to the camp.

Spare Parts

Spare parts were purchased in Brisbane or Alice Springs or Oodnadatta and trucked or air freighted to the camp.

Explosives

Explosives were purchased through I.C.I.'s South Australian depot and were railed and trucked to camp. They were delivered to Petty Ray's licenced shooter for storage in Petty Ray's licenced magazines in the programme area. Sufficient quantities for each day's operation were drawn from the field magazine.

COMMUNICATIONS

Radio Communications

Inter-camp, weight truck and recorder communications were facilitated by the provision of 13 Motorola VhF radios. Four Codan SSB radios were used for inter-field and Brisbane-camp communication. These radios were fitted with the relative R.F.D.S. frequencies.

Sydney Oil's field representative communicated daily to Sydney Oil's Broome base by Codan SSB radio on the 7 MHz band. This arrangement was not totally satisfactory and a proper dipole antennae system was proved to be necessary. The radio telephone facility of the radio proved to be excellent for communications, but of course was limited in time.

Crew Rotation

Once weekly, a crew change plane flew to the strip near Colson # 1. All personnel were flown to Alice Springs.

Airstrip Co-ordinates	Latitude	25°	56' south
	Longitude	136°	38' east

TERRAIN AND WEATHER

TERRAIN

The terrain consisted of a rolling, predominantly sandy surface with sub-ordinate clay pans. An irregular succession of sand dunes was superimposed on this surface with frequency of approximately 4 per km and heights of up to approximately 10 metres. The dunes were persistent with very few breaks along their length, and were orientated in a north west to south east direction with steeper faces to the east. To properly equipped and driven vehicles, the dunes were not a great impediment. The lines programmed parallel to the dune orientation were accessed much more easily since the dune directivity was quite constant.

Vegetation consisted of spinifex and low scrub.

WEATHER

The weather was generally clear but very hot, cooling down for only a few hours at night.

Windy conditions were quite common and excessive wind noise caused 1.50 hours of downtime. Towards the end of the job, isolated rain storms caused 4.0 hours of leakage downtime.

PERMITTING AND FENCING

The Colson Seismic Survey was conducted over vacant Crown Land and no fences were observed.

However Sydney Oil Company consulted with the Aboriginal and Territory authorities to determine the locations of sacred sites and sensitive areas. None of these existed in the Colson area.

LINE CLEARING

For a listing of performance, equipment and personnel, please refer to the Appendices.

M.E.S. of Perth were employed on an hourly contract, which is suitable for the terrain.

Lines were cut to an average width of approximately 6 metres and the depth was kept as shallow as possible to avoid later erosion.

Lines were set off for the dozers by a surveyor with at least two sighter pegs to establish the correct bearing. The operators then maintained their own direction with assistance from the surveyor when necessary.

The quality of the line clearing was reasonably good.

The productivity per working hour was poor.

Many night shifts had to be introduced to maintain the dozer lead but productivity was still low and costs very high.

Sydney Oil's seismic operations supervisor in Sydney visited the contract to ascertain the problems. They were many and varied but the low productivity was primarily due to almost non-productive night shifts, little or no supervision from all parties, and unnecessary work in that dune detours were being constructed in addition to extensive cutting down of the same dune along the track of the line.

The night shifts were cancelled and firm instructions and guidelines were given to all concerned. From that date (January 27) onward line clearing productivity moved almost immediately to an acceptable level, but the damage had been done.

The bulldozers used (one D-8 and one D-7) were suitable for the terrain although a D-9 would have been more cost effective. The grader supplied (a

Caterpillar 16G) was almost totally non-productive, being too unmanouverable for line grading and too weak for line clearing, and was badly equipped with tyres. It was also very expensive, and fortunately broke down with a major transmission problem on January 28 and was replaced by a Caterpillar 12 grader which should have been employed in the first place.

M.E.S.'s operators and supervisors tried hard but were very inexperienced. The line clearing operator was fairly supported by M.E.S.'s base in Perth except for their failure to react to the abyssmal productivity. Supervision by Petty Ray Geophysical was considered to be poor.

Overall, the line clearing operation was inefficient and very expensive.

SURVEYING - FIELD PROCEDURES AND MEASUREMENTS

For a listing of equipment and personnel please refer to the Appendices.

LINE SETTING OUT AND RELATIONSHIP TO PROGRAMMED POSITION

Line bearings were calculated from scaled co-ordinates of the ends of the lines from the 1:100,000 programme map. The set out points were determined by scaled distances from permanent markers, also off the programme map. In the field the set outs were effected by either chained or measured distances from a known shot point or PM and bearings established from a known bearing or sun shot.

Work commenced on line 6 from Colson # 1. Line WMM, extending from the adjacent permit, also ties Colson # 1.

Line 1 had a programmed bend at its intersection with line 8. Due to poor line clearing and poor line clearing supervision a bend was made to the west of the programmed position albeit in the wrong direction and consequently there was an excessive bending (14°) at the intersection with line 8. Tails were cut so as to allow for acceptable recording at the 14° bend area.

All other lines were cut reasonably close to their programmed position.

CHAINING

Steel survey pins were placed at every station along the line. The station interval was 30m for all lines. These stations were numbered consecutively from 100 at the start of each line in the north or west. The station interval was measured with a plastic coated steel cable calibrated daily to a fibreglass tape.

Chaining notes were compiled for each line showing all features and existing lines that intersect the line.

SURVEYING

Vertical control was maintained using standard trigonometric levelling procedures. Left and right face vertical angles were observed from both directions with a time span of less than 20 minutes.

Horizontal control was maintained by reading left and right face horizontal arcs and measuring slope distances twice. Bearings were checked and adjusted to sun observations approximately every 10kms.

All loops surveyed were found to be good.

Hanging lines were double run.

Three satellite positioned locations were installed by Geomeasure of Brisbane. These were at strategic locations and were used as primary control. Two Magnavox MX 1502 Geoceivers were used by Geomeasure.

PERMANENT MARKERS

Star iron pickets with aluminium tags attached stating line number and station numbers, where used as witness marks. A dumpy peg cemented at the base served as the instrument station and bench mark for the permanent marks. Permanent markers were placed at the end of lines, existing and new line intersections and at least every 5kms.

The survey field procedures were carried out efficiently except for the example of line 1. The personnel and equipment were generally of a fairly high standard except for the vehicles.

Productivity was initially very satisfactory but then was limited by the lack of graded line due to the grader's problems.

SURVEYING - COMPUTATIONS

The Apple computer did not work in the field during the contract. Various parts supplied to expedite its use were either incorrect or did not work so the field value of the computer was nil.

The surveyors did all computations by hand held calculators and were always well ahead of recording.

UPHOLE DRILLING

For a listing of performance, equipment and personnel, please refer to the Appendices.

Petty Ray Geophysical supplied their own equipment and personnel for the job on a turnkey contract.

The contract was originally for the provision of 125 upholes to depths of 50 metres. This provided an uphole spacing of 2km. It was soon apparent that the base weathering was deeper than anticipated so the contract was adjusted and 62 upholes ranging from 60 metres to 90 metres were drilled with an average depth of 85 metres. The modus operandi was to drill as many holes as possible.

Formations drilled were sand, sandy clays, sandstones and clays and most holes had to be mud pitted.

The drill penetration rate was considered to be fair. Actual drilling productivity was very good and the rig was well equipped and manned.

However much greater productivity could have been achieved with drilling equipment mounted on buggies since the mobility of the trucks in the sand and especially on the east west lines was very poor. Eventually a log skidder was hired, and without its towing assistance the programme would never have been completed. More time was spent on moving between holes than on drilling and the long travel times further contributed to less productivity than should have been achieved. The provision of water was a big problem until, after numerous delays, the water well at Macumba was operational. These delays were due to lack of forward planning. Likewise the provision of an extra water truck was delayed for the same reason.

The drill unit had much downtime primarily for mud pump failure and waiting on stem. The original stem had faulting pins and boxer.

Support from Petty Ray's base in Brisbane was only fair.

The drilling operation, while achieving its limited objective, was disappointing in the productivity of one uphole per 4.2kms of line.

With better forward planning and reference to a recent survey in the adjacent part of South Australia, the operation could have been very good.

UPHOLE PRE-LOADING

Petty Ray provided a licenced pre-loader with a licenced Toyota 4 x 4 pick up truck to prepare the harness and load the hole as soon as drilling was completed.

The holes were loaded with one detonator at 5m and 10m, "A" boosters from 15 to 30m at 5m intervals and from 30m to the bottom of the hole at 7m intervals.

The number of misfires was minimal, and the pre-loading operation was carried out quickly and efficiently.

UPHOLE RECORDING

For a listing of personnel, equipment and uphole locations, please refer to the Appendices.

As explained under "Uphole Drilling", the original concept of the programme was to locate upholes at line intersections, and at 2km intervals. The concept was subsequently changed to an approximately 4km interval. Uphole depths were to be such that the weathering base was penetrated by at least 15m or 3 normal shots, and in areas of considerable surface to datum plane distance, to drill the upholes as close as practically possible to the datum plane.

In the event, the spacing was approximately 4.2km.

Four geophones connected to two separate traces were offset at distances of 1m and 3m from the top of the hole. The camera records were "picked" on the line. The travel times were averaged and corrected for offset, and were plotted on a time versus depth graph. Hence a measure of control over the drilling programme was maintained.

Only on rare occasions did uphole recording lag uphole drilling by more than a few hours.

The equipment used was satisfactory.

Record quality was good and camera presentation acceptable. Cap tests were done daily to check instrument delay.

Uphole recording was generally conducted very competently.

UPHOLE RESULTS, STATICS AND DATA SHIPMENTS

In addition to the on line Q.C. plot, each uphole was plotted in the field office and recorded lithologies were logged.

The near surface was relatively simple with a 3 layer case.

Weathering velocities ranged from approximately 400 to 1400ms. The sub-weathering velocities ranged from approximately 1800 to 2700ms. known weathering depths ranged from 37 to 80 metres and were not apparently controlled by elevation.

Of the 62 upholes drilled only one did not penetrate base weathering. The refraction method would apparently work in this area but is not recommended.

For each line a cross sectional elevation plot was made, on which uphole locations, depths, velocities and lithologies were marked. The datum plane was sea level. For those upholes which penetrated the datum, the relevant uphole time logged was adopted as the static. For the majority of upholes which did not penetrate the datum, a reasoned static estimate was made by study of the cross section. Most upholes were drilled to within a few metres of sea level.

On Sydney Oil's instructions, the uphole camera monitors, time depth plots and cross sections, were forwarded with the reflection data to the processing centre in Perth, on a line by line basis.

Data shipments were strongly monitored and despatches were regular.

PRODUCTION RECORDING

For listings of parameters, performance, equipment and personnel, please refer to the Appendices.

QUALITY CONTROL PROCEDURES

Monthly instrument tests were carried out monthly, before production commencement and after production conclusion. All of these tests were satisfactory.

Daily instrument tests were carried out each morning before production began and were inspected in the recording truck immediately after they had been carried out.

Geophones were checked on a rotational basis in camp.

Geophone and weight truck plants and spacings were generally good.

Sydney Oil instituted a set of rules regarding the number of dead traces, procedure for recording of recoveries etc., and these rules were strictly observed.

Monitors were produced for every drop point and alternate sides of the spread were displayed. A continuous data display was provided on a Tektronix Oscilloscope.

In general, recording truck and line quality control was of a high standard.

Originally it was planned to sue two weight trucks and operate them alternately but because of truck mobility and other problems one truck was used for the majority of the survey.

RECORD QUALITY

Initial recording parameters were determined by the experimental work of January 10 and 11 on line 6.

Production commenced on line 6 and data quality was very fair with a strong reflector at 1.9 seconds and others above it. Line 1 was commenced with two important parameter changes. The centre gap was reduced to zero and a low cut filter of 9 Hz was introduced. The cross dune line 1 had fair quality but the next corridor lines (lines 8 and 4) were fair to good. This pattern continued but overall quality deteriorated to the north east of the prospect. Long wave length ground roll, while not serious, increased in that direction.

Overall quality was fair and the weight drop method is considered to be very appropriate for the area.

PRODUCTIVITY

Overall productivity was 0.74km per total work hour which was very poor. The limits to productivity were very high down and travel time, and the selection at programme commencement of an inexperienced line crew. However, from a very poor beginning, the recording crew developed into an efficient unit.

The crew did not attempt to sacrifice quality for speed on a turnkey contract and rarely had to be instructed to rectify the occasional error.

The recording crew was well equipped except for its vehicles and the operation was considered to be successful.

CAMP EQUIPMENT AND PERSONNEL

For listings of camp equipment and personnel please refer to the Appendices.

EQUIPMENT

The trailers used by the crew, while well constructed, were not truly appropriate for the local conditions. The running gear was too light and small for the sandy terrain and forced the crew into a long travel situation for the eastern part of the prospect since the camp could not be moved.

The trailers were well equipped and had plenty of storage, workshop, and office space, but the air conditioning and refrigerating systems were poor. When the line clearers were forced to add a night shift operation, accommodation space was severely strained.

Water and fuel storage was very good and abundant electrical power was usually available.

In summary, the base camp equipment was just fair.

The fly camp for the surveyors was originally a part of the base camp. Even with the assistance of the log skidder it managed to move only 13km from camp because of its unsuitable running gear.

PERSONNEL

The cooking staff provided very good food, the camp was kept very clean, linen changes were frequent and a tolerable living atmosphere existed.

The mechanics were very hardworking as well as being excellent technically. The camp was never short of fuel and food but for the first half of the survey, water (for all purposes) and cool drinks were in very short supply.

The camp paperwork was done in a most efficient manner.

Party 6316 did not have a good camp. Morale initially was very low but gradually improved.

FIELD MANAGEMENT AND ORGANISATION

In general the field management of the crew was fair. Strong leadership was provided which also displayed genuine concern for the safety and well being of the crew.

However the individual sections of the crew initially were allowed to act as individuals, and thus initially crew coherence was only fair. This problem was slowly rectified.

The crew was reasonably well briefed and information was disseminated readily.

After a poor start the field management visited the field activities fairly regularly and were always available for advice and decisions.

The organisation at the commencement was poor and confused because the crew was poorly equipped, manned and prepared for the terrain.

CONCLUSIONS

1. The data quality was generally fair but deteriorated to the east.

2. The productivity of the recording crew was poor. High down and travel times limited productivity. However, after a very poor start, the crew improved steadily and finished well. Technical competence was satisfactory.

3. The weight drop (or thumper) method was appropriate for the survey.

4. Line clearing performance was inefficient and very expensive. After re-organisation of the operation, productivity rose considerably.

5. Surveying was generally satisfactory, and the crew responded very well to the deficiencies of the survey computer.

6. The drilling penetration rate was very acceptable but too much lost time accrued due to the unsuitability of the equipment for the terrain.

7. The uphole programme achieved its reprogammed objectives but more near surface information could have been obtained with more suitable equipment.

8. Camp conditions were just fair.

9. Crew management was fair but supervision of the sub-contractor was below standard.

10. The job was beset with problems which would have been largely eliminated with competent pre-survey planning. On arrival, the crew was not prepared with the correct personnel and equipment to handle the terrain.

11. The contractual format used for the Colson Seismic Survey was successful.

RECOMMENDATIONS

1. Buggy drills and water buggies, if available, must be used for this prospect for cost effective performance. The terrain on the cross dune lines is impossible for large trucks. If buggy equipment is not available, two log skidders must be used to move the equipment.

2. If future work is planned for this area, two drills should be used. One drill should be mobilised well ahead of the operation to locate water in the programme area. This drill should have at least 200 metres of stem. The uphole programme should start well ahead of reflection recording since the apparent attainment of the uphole programme for the 1984 Colson survey was a compromise.

3. For future uphole work in this area the drill unit should have a minimum of 150 metres of stem. Also the probability is that an auxiliary air compressor of high performance (170 psi and 750 cfm) would improve efficiency and reduce water usage.

4. For operations in this difficult area the seismic contractor should show demonstrable proof of ability and preparedness of equipment and personnel to carry out efficiently the entire operation before it commences.

5. Future line clearing operations for this area should incorporate a D-9 bulldozer for the heavy sand dune work, in place of a D-7, and the grader should be used only to grade.

6. In the absence of proper supervision of sub-contractors by the crew, the client's field representative should be on site from the time of the survey's first activity so as to ensure financial and operational control as well as quality control.

7. A turnkey based contract for the seismic crew and drilling is the most suitable for this area. An hourly contracted crew would not be cost effective and would tend to blame all problems on the terrain. For line clearing, an hourly contract under very close supervision is recommended.

8. If a turnkey based contract for seismic acquisition could not be obtained, then a helicopter supported operation would be the most cost effective, because of the long travel times a conventional crew would log.

9. Field data processing capability would be an advantage in the area as an aid to parameter evaluation.

APPENDIX A-1

UPHOLE LOCATIONS AND DEPTHS

LINE NO.	STATION	DEEPEST SHOT (M)	DEPTH OF WEATHERING
S84C-01	160	90	47
	403	90	47
	482	88	58
	583	90	51
	631	90	48
	696	90	65
	795	90	60
	931	90	52
	1077	90	53
S84C-02	161	90	62
	280	90	50
	401	90	49
	551	90	53
S84C-03	106	90	51
	233	90	63
S84C-04	107	90	38
	229	90	47
	338	90	41
	436	90	43
	533	85	50
S84C-05	107	90	71
	194	90	64
	267	60	48
	332	90	40
	345	90	46
	434	60	44
	510	60	*60+
	586	90	41
	664	90	68

LINE NO.	STATION	DEEPEST SHOT (M)	DEPTH OF WEATHERING
S84C-07	106	90	52
S84C-08	108	90	58
	491	75	41
	623	75	52
	709	75	59
S84-09	300	90	64
	723	90	51
	820	90	40
	920	90	46
	1020	90	52
	1123	90	55
	1219	90	45
	1322	90	65
	1422	86	44
S84C-10	106	90	44
	243	90	65
	360	90	47
	448	90	47
	559	90	51
S84C-11	110	90	80
	393	85	53
	525	79	58
S84C-12	108	90	39
	241	90	37
	360	90	43
	448	90	52
	573	90	48
	681	90	56

LINE NO.	STATION	DEEPEST SHOT (M)	DEPTH OF WEATHERING
S84C-15	108	90	55
	205	90	45
	274	90	64
	371	90	62
	583	90	53

* THESE UPHOLES DID NOT PENETRATE BASE OF WEATHERING.

APPENDIX A-2

RECORDING PARAMETERS

LINES S-85-C-1, 1A, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 15

INSTRUMENTATION

Instruments	:	MDS-10
Number Channels	:	120
Tape Format	:	Seg - B, BPI - 1600
Sample Rate	:	2 MS
Record Length	:	5 S
Filters, Slope	:	Hi-cut 62.5 Hz, 72 DB/OCT
		Lo-cut Out Hz, 18 DB/OCT

SOURCE

Weight truck	:	Kenworth Long Reach 400
Electronics	:	WDC-6, HCU-6
Drops/DP	:	8
Array	:	No. 1, 0, moveup 8.57m

RECEIVER

Manuf./Model/ Res. Frequ.	:	Sensor/SM-4/10 Hz
No./String, How Connected	:	12 Series
Array	:	12 Inline @ 5.4m spacing

SPREAD

Group Interval	:	30m
Sub-surface coverage	:	2000%
Receiver Location	:	Centred on flag
DP Interval	:	90m
DP Location	:	Between flags
Gap	:	0 stations
Spread	:	1785-15-0-15-1785m

APPENDIX A-2

RECORDING PARAMETERS

LINES S-85-C-06

INSTRUMENTATION

Instruments	:	MDS-10
Number Channels	:	120
Tape Format	:	Seg - B, BPI - 1600
Sample Rate	:	2 MS
Record Length	:	5 S
Filters, Slope	:	Hi-cut 62.5 Hz, 72 DB/OCT
		Lo-cut out Hz, 0 DB/OCT

SOURCE

Weight truck	:	Kenworth Long Reach 400
Electronics	:	WDC-6, HCU-6
Drops/DP	:	8
Array	:	No. 1, 0, moveup 8.578m

RECEIVER

Manuf./Model/ Res. Frequ.	:	Sensor/SM-4/10 Hz
No./String, How Connected	:	12 Series
Array	:	12 Inline @ 5.4m spacing

SPREAD

Group Interval	:	30m
Sub-surface coverage	:	2000%
Receiver Location	:	Centred on flag
DP Interval	:	90m
DP Location	:	Between flags
Gap	:	6 stations
Spread	:	1875-105-0-105-1875m

COMMENTS

* 4 and 12m move-ups also used but 8m predominant

APPENDIX A-3

PERSONNEL

SUPERVISORY AND SUPPORT PERSONNEL

Access to the Management of Geosource Offices worldwide (Houston, Texas, London England, etc.) and particularly Brisbane Australia, to assist in solving technical problems, crew logistics and any other requirements.

One (1) Supervisor (non exclusvie) but assigned to the crew - based in Brisbane Australia.

One (1) Instrument Engineering (non exclusive) - based in Brisbane, to be on call at all times.

STAFF PERSONNEL

One (1) Party Manager
One (1) Seismologist
One (1) Senior Observer
One (1) Observer
One (1) Senior Surveyor
One (1) Surveyor
One (1) Chief Mechanic
One (1) Mechanic
One (1) Uphole Observer
One (1) Driller

NATIONAL UTILITY PERSONNEL

One (1) Cook
One (1) Cook's Assistant
One (1) Camp Attendant
Two (2) Mechanic Assistants
One (1) Line boss
Ten (10) Recording Helpers
One (1) Shooter/Preloader
One (1) Drill Helper
One (1) Supply Driver
One (1) Water Truck Driver

Two (2) Surveyor Helpers

Two (2) Weight Truck Operators

Additional personnel were assigned to permit a leave rotation.

LINE CLEARING PERSONNEL (M.E.S. Pty Limited)

Three (3) Operators

One (1) Supervisor

One (1) Mechanic/support

APPENDIX A-4

EQUIPMENT

RECORDING EQUIPMENT

One (1) ETL MDS-10 120 Trace Digital Field System
One (1) SDW-400B 60 Trace Electrostatic Camera
One (1) LT-240 Line Checker
One (1) RLS-240/120 Rotary Switch
Three (3) SMM 1 Mass Memories

TEST EQUIPMENT AND RADIO COMMUNICATIONS

One (1) Geophone Checker
One (1) Tektronix 465 Oscilloscope
One (1) Precision DC Source
Four (4) 100 Watt SSB Radios
Ten (10) VHF Radios (General Duties)
Three (3) VHF Radios (Weight Truck Control)

CABLES AND GEOPHONES

Sixty-nine (69) Cables Sections - each with four takeouts at 35 metre intervals .127 pair Cables
Four hundred twenty (420) strings of Sensor SM-4, 10 Hz Geophones - each string has 12 phones at 10 metre intervals
Two (2) Extension Cables - each 100 metres long

SURVEY EQUIPMENT

One (1) DI-4 Wild Distomat
Two (2) Wild T-16 Theodolites and Accessories
One (1) Precision Chain
One (1) Survey Computer System (Apple)
Drafting equipment

DRILL EQUIPMENT

One (1) Bourne, 1000R air-water combination tip mounted on 6 x 6 Mack
One (1) Water truck, mounted on 6 x 6 Mack

UPHOLE RECORDING EQUIPMENT

One (1) Blaster
One (1) Nimbus Refraction System
Six (6) Geophones Geospace GSC-20D 4 Hz

VEHICLES

Fourteen (14) 4 x 4 HJ47 Toyota trucks, equipped to carry out:
- One (1) Mechanic's vehicle
- One (1) Party Manager's vehicle (station wagon)
- Two (2) Recording crew vehicles
- Three (3) Personnel carrier (station wagon)
- Two (2) Surveyor vehicles
- Three (3) Utility vehicle (tray body)
- One (1) Shooters vehicle
- One (1) Uphole recording instrument vehicle

Two (2) Leader 6 x 6 trucks equipped to carry out:
- One (1) Cargo/general duties equipped with hydraulic crane
- One (1) Water truck

Five (5) Isuzu 4 x 4, 4 ton TSD45 trucks equipped to carry out:
- Four (4) Recording crew
- One (1) Maintenance unit

One (1) International 4 x 4 1854S Recording truck
Three (3) Weight drop trucks (two on line) 6 x 6
One (1) Leyland 6 x 6 water truck
One (1) John Deere log skidder

CAMP

One (1)	Kitchen trailer
One (1)	Dining trailer
Four (4)	10 man sleeping trailers
One (1)	Ablution trailer
One (1)	Office trailer (including accommodation for Party Manager and Client Representative)
One (1)	Store/workshop trailer
Two (2)	Generators - 90 KVA
One (1)	Fuel storage trailer - capacity 1500 gallons or equivalent
One (1)	Water storage trailer - capacity 1500 gallons or equivalent
One (1)	Workshop and maintenance facilities for all equipment
One (1)	Explosives magazine
One (1)	Detonator magazine

LINE CLEARING EQUIPMENT (M.E.S. Pty Limited)

One (1)	D8 - bulldozer
One (1)	D7 - bulldozer
* One (1)	Cat. 16G - grader
Two (2)	HJ47 4 x 4 Toyota support vehicles

* Replaced on January 31 by Cat. 12E grader

APPENDIX A-5

REIMBURSIBLE USAGE

1. UPHOLE EXPLOSIVES

1.8m Detonators	:	930
A Boosters	:	1240
550m rolls bell wire	:	90

APPENDIX B-1

LINE CLEARING

PRODUCTION (HOURLY CONTRACT)

Dozer	Work	:	891.25
	Down	:	20.75
	Standby	:	7.00*
16G Grader	Work	:	195.75
	Down	:	118.25
	Standby	:	0
12E Grader	Work	:	92.75
	Down	:	6.00
	Standby	:	0
Kilometres cleared and graded		:	259.09
Productivity		:	0.29 km/hr

NON-PRODUCTION (ACCESS)

Dozer	Hours charged	:	10.00
Grader	Hours charged	:	57.00

DOWNTIME

DOZERS	
Hydraulics	9.00
Batteries	3.50
Injectors	3.00
Shut down by recording crew	5.25
16G GRADER	
Flat tyres	46.25
Transmission	36.00
12E GRADER	
Clutch	6.00

APPENDIX B-2

UPHOLE DRILLING

PRODUCTION (TURNKEY CONTRACT)

Holes drilled	:	65*
Metres drilled	:	5272
Hours worked	:	179.50
Hours travel	:	62.50
Hours wait on water	:	18.00
Hours down	:	118.00*
Hours standby	:	0
Total work hours	:	260.00
Penetration rate	:	20.28 m/hr

* Including 3 re-drills

NON-PRODUCTION (HOURLY CONTRACT)

Holes drilled	:	0
Metres drilled	:	0
Hours charged	:	0

* DOWN TIME

Mud pump	:	41.00
Waiting for stem	:	46.50
Bogged water truck	:	10.00
Shut down by recording crew	:	10.00
Log skidder not available	:	9.00
Water truck down	:	1.50

APPENDIX B-3

RECORDING

PRODUCTION (TURNKEY AND HOURLY CONTRACT)

Lines recorded	:	14
Kms recorded	:	259.09
Drop points recorded	:	2883
Hours work	:	240.75
Hours travel	:	54.50
Hours down	:	66.00*
Hours line move	:	50.75
Hours standby	:	4.0
Hours for re-recording	:	4.00**
Hours total work	:	250.00
Hours charged	:	4.00
Productivity	:	0.74 km/hr

EXPERIMENTAL (HOURLY CONTRACT)

Hours work	:	13.50
Hours travel	:	0.50
Hours standby	:	0
Hours total work	:	14.00
Hours charged	:	4.00

* DOWN TIME

Instruments	:	5.25
Weight trucks	:	27.75
Recording truck	:	5.00
Cables/geophones	:	3.00
Line vehicles	:	17.75
Leakage	:	4.00
Dozer noise	:	1.75
Excessive wind	:	1.50