Report No. NT/2/103.

OPEN FILE

REPORT

ON

A MARINE REFLECTION SEISMOGRAPH SURVEY IN THE PORT KEATS AREA, O.P.2 NORTHERN TERRITORY.

By :

Mines Administration Pty.
Limited.

Submitted to : Associated Australian Oilfields N.L.
31 Charlotte Street,
Brisbane.

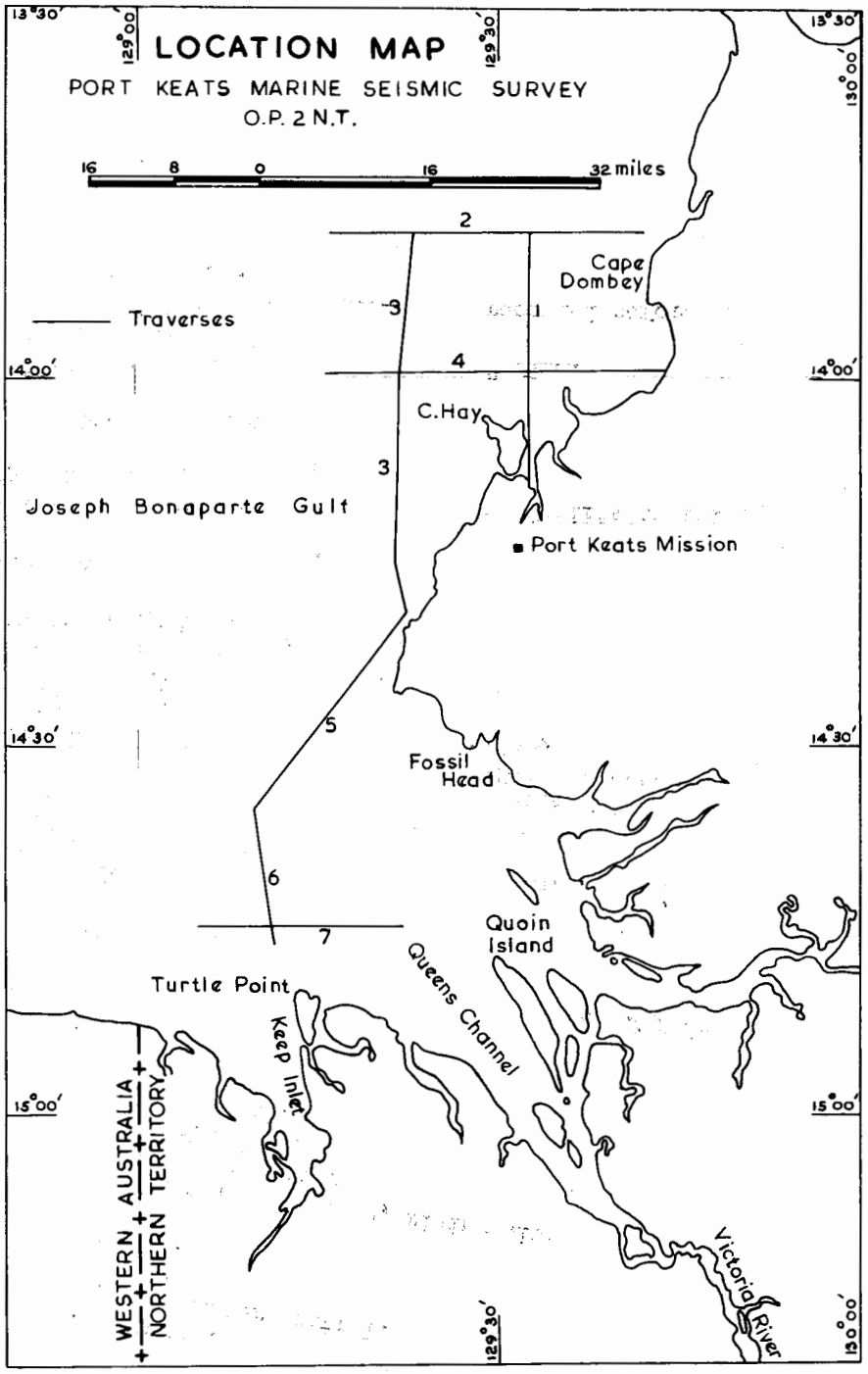
by : Mines Administration Pty. Limited,
31 Charlotte Street,
Brisbane.

January, 1962.

ONSHORE

C O N T E N T S.

A P P E N D I X.


LOCATION MAP
PORT KEATS MARINE SEISMIC SURVEY
O.P. 2 N.T.
16 8 0 16 32 miles
Traverses
Cape Dombey
C. Hay
Joseph Bonaparte Gulf
Port Keats Mission
Fossil Head
Quoin Island
Turtle Point
Keep Inlet
Queens Channel
Victoria River
WESTERN AUSTRALIA
NORTHERN TERRITORY
13°30'
129°00'
129°30'
130°00'
14°00'
14°30'
15°00'

INTRODUCTION :

The marine reflection seismic survey, 1961, of Bonaparte Gulf was carried out by Party 179/G of Seismograph Services Limited of London, under contract to Mines Administration Pty. Limited, the technical and administrative Company for the "Associated Group" consisting of :-

Associated Australian Oilfields N.L. (Titleholders)
Associated Freney Oil Fields N.L.
Associated Continental Petroleum N.L.
The Papuan Apinaipi Petroleum Company Limited.
Interstate Oil Limited.
H.C. Sleigh Exploration Limited.

The planning, supervision and portion of the Report were the responsibility of J.E. Burbury, Geophysicist, and D.M. Traves, Exploration Manager of Mines Administration Pty. Limited. J.E. Burbury was also responsible for the field supervision of the survey. R.D. Lugg was Party Chief and D.A. Hartley, Operations Manager of Seismograph Services Limited.

The survey was approved by E.N. Avery, Managing Director and other Directors of the Board of Mines Administration Pty. Limited.

SYNOPSIS :

The marine reflection seismic survey described in this report was conducted in the area designated as the Port Keats Marine Prospect, which covered Port Keats Entrance and Eastern coastal waters of the Bonaparte Gulf from Cape Dombey in the north towards Turtle Point in the south.

The survey was designed to determine the thickness and structural configuration of the Palaeozoic sedimentary section in the coastal area of the Port Keats Sub-Basin and in particular, whether the oil prospective Carboniferous, Devonian and Cambrian rocks of the Keep River area extend northwards and occur below the mantle of Permian outcrops in the Port Keats Sub-Basin.

Gravity surveying throughout the Bonaparte Gulf Basin has indicated that major sedimentary thickening occurs in the Port Keats Harbour area. Recent seismic surveying to the south of Port Keats Mission also indicated that the sedimentary section was thickening to the north. The two east-west marine seismic lines north of Port Keats Mission were intended to confirm that a thicker sedimentary section occurs in this area than that occurring south of the Mission. The marine seismic line from Port Keats Harbour south to connect with the 1960 Port Keats seismic work and traverse Queens Channel to the mouth of the Keep River, was designed to determine whether any of the Palaeozoic units of the Keep River Sub-Basin can be traced from one area to the other and also investigate the nature of the large gravity high mapped in the Queens Channel.

Shooting commenced on 15th September, 1961, and terminated on 20th September, 1961, during which time 185 miles of traverse were shot.

Weather conditions were good throughout the project.

The survey was conducted as a three boat operation using the 35 ton barge m.v. "Tamona" as recording boat and the 45 foot launch "Zena" as shooting boat. The 300 ton fishing vessel m.v. "Laakanuki" was used as a mother ship and also assisted in locating the shot points.

The positioning of the survey was effected by dead reckoning.

A winch system for releasing and recovering the geophone cable for each shot allowed the recording and shooting boats to steam at constant speed through the water.

All shots were recorded on magnetic tapes which were replayed in Wyndham to give variable area time sections, corrected for dynamic step-out, from which the field interpretation was made. No conventional records were taken but a density modulated display unit gave an instantaneous dynamically

prospect area, at the junction of Lines 2 and 3, by a major anticlinal feature. No definite closure is shown on the contour maps. However, the greater part of this feature appears to lie to the north of Line 2, outside the area covered by the survey, where critical north-east dip may occur.

Immediately to the south of this anticline faulting, upthrown on the south, is postulated on Line 3.

The regional north-west dip persists over the southern portion of the prospect area with the exception of two prominent anticlinal folds centred about shot points 515 and 597 on Line 5.

RESULTS :

The sections show fair to good reflection quality and continuity except in the south on Lines 6 and 7 where the continuity deteriorates, especially on the deeper events.

Horizon 'A'.

Over the whole northern area the sections are characterised by two shallow reflections which show excellent continuity and can be readily correlated throughout the area, with the exception of the portion of the fault zone on Line 3 between shot points 246 and 258.

Horizon 'A' was chosen to coincide with the deeper of these two reflections which are separated by a time interval of approximately 0.250 second.

In the southern area these reflections can still be followed until they become so shallow that interference occurs between the reflected energy and the water transmitted energy; for this reason, Horizon 'A' was discontinued at shot point 639 on Line 6 at a reflection time of 0.250 second below datum.

The contour map shows north-west regional dip interrupted by a prominent anticlinal feature situated immediately north and east of the intersection of Lines 2 and 3.

This feature shows a sharp reversal on Line 3 with 0.150 second of north dip mapped to the northern extremity of the Line at shot point 216, and 0.170 second of south dip against the fault at shot point 239.

On Line 2, the west flank is well developed and shows 0.370 second of regional dip to the end of the line at shot point 215 with the possibility of minor faulting at about shot point 182, which would be upthrown the east. East of the intersection of Lines 2 and 3, the horizon is virtually flat along Line 3 except for minor undulations and remains at the

definite closure is shown on the contour map; however, since it would appear that the greater part of this anticline lies to the north of Line 2 and outside the area surveyed, it is possible that some closure does exist further to the north-east.

The syncline which is centred at shot point 151 on Line 2 has been contoured as extending in a south-westerly direction into the fault zone on Line 3.

This faulting has been postulated because of the marked change of character on Line 3 between shot point 239 and shot point 259 on the two strong shallow reflections which elsewhere show persistently good character and continuity. These two reflections can be readily correlated between shot point 239 and shot point 259; however, although two weak events of similar time interval can be distinguished between shot point 241 and shot point 245, no such events can be recognised on the section between shot point 246 and shot point 258.

Correlation between these two weak reflections and the stronger reflections north of shot point 239 indicates a fault upthrown to the south at shot point 239. Similar faulting has also been postulated at shot point 259 south of which point the two strong reflections can again be readily distinguished; the throw of this southerly fault cannot be accurately determined due to the total loss of correlatable reflections north of shot point 259 and, similarly, the contouring within the zone of faulting must be considered conjectural only.

Elsewhere within the northern prospect area, the map shows uniform regional north-west dip with minor terracing on Line 1 between shot points 55-57 and a small anticlinal fold on Line 4 at shot point 298.

South of Line 4, the programme consisted of long reconnaissance lines and no closed loops were surveyed; Horizon 'A' in general rises to the south consistent with the north-west regional dip mapped further north; however, folding results in the formation of two prominent anticlinal reversals centred about shot points 515 and 597 on Line 5.

The reversal at shot point 515 exhibits 0.300 second of south-west dip into the major synclinal reversal mapped at shot point 550; the reversal at shot point 597 shows 0.170 second of north-east dip into the same syncline and 0.060 second of south-west dip into the flanking syncline at shot point 604.

Horizon 'B'

Horizon 'B' was chosen as a deeper phantom horizon which generally

Due to this discontinuous nature of the deeper results, the contour map of Horizon 'B' is of a lower order of reliability than Horizon 'A' which continuously maps an identifiable event.

The contour map of Horizon 'B' shows identical structural features to that of Horizon 'A' but, at this depth, the relief is considerably greater. Over the northern area for example, the overall north-west dip on Horizon 'B' is 1.400 second as compared to 0.720 second on Horizon 'A'. It is worth noting that this amount of dip on Horizon 'B' is approximately twice that of Horizon 'A' and the possibility of multiple reflections influencing the deeper horizon cannot therefore be completely eliminated.

To the south of the point on Line 6 where Horizon 'A' was discontinued, Horizon 'B' is featureless and continues to demonstrate the north-west regional dip trend.

GEOLOGICAL INTERPRETATION :

The results of the marine seismic survey in the Port Keats and Keep River areas have shown that the sedimentary section increases in thickness seawards over the whole of the area investigated, that is, from Cape Dombey in the north to Quoin Island in the Queens Channel. The general trend in increase of section is north-westerly. This trend is clearly indicated in the northern part of the survey area and although little directional control of trend is afforded by the regional lines to the south (lines 3, 5, 6, and 7), a persistence of the north-west trend to the south appears to conform with the observed data.

In the northern part of the survey area both seismic horizons mapped show a major irregularity in the north-west trend. This occurs near the junction of Lines 2 and 3 where a reversal of dip of approximately .150 seconds indicates an anticlinal structure extending to the north-east. West of the junction of Lines 2 and 3 the north-west dip increases and the lower horizon, Horizon 'B', shows a maximum reflection time of 2.560 seconds at the end of Line 2, and is seen to be still dipping to the west. The depth to Horizon 'B' would be approximately 12,000+ feet in this area.

Along Line 4 both horizons show a continuous increase in depth to the west apart from a very small reversal near shot point 297, which could be due to surface reef development in this area, and a sharp reversal of the west dip on the extreme western end of the line.

The reflection results in the northern area indicate that the sedimentary section increases in thickness to the west and that the major

The results of gravity surveying over this northern area had indicated that the axis of sedimentation in the Port Keats Basin extended north through the Port Keats Harbour and that the basin broadened to the north. As shown above the seismic surveying does not confirm the conclusions drawn from the results of the gravity surveying. More detailed gravity surveying may indicate a relationship between seismic and gravity results, but at present the gravity results cannot be relied upon to indicate basin trends in the Port Keats area.

Throughout the whole of the survey area some reflection events occur below Horizon 'B', however, their continuity is poor and they appear on a few consecutive records only. It is possible that these sporadic reflection events could be originating from the same section that gave rise to the numerous deep partial reflections mapped by Austral Geo Prospectors Pty. Ltd. during the land seismic survey (1960). These deep partial reflections showed angular unconformity to the overlying section and it was considered that the unconformity was the base of the Palaeozoic section. The deeper reflections mapped during the marine survey appear to be conformable with the overlying section and hence no suggestion of the base of the Palaeozoic is indicated.

Shot point 515 of the marine survey is approximately 1 mile west of shot point 170 of the Austral Geo Prospectors Pty. Ltd. land survey. Reflections at times of approximately 1.300 and 2.000 seconds appear on both records. The record quality at shot point 170 is very poor however, and the numerous reflections observed at shot point 515 are not seen on the record of shot point 170. East of shot point 170 very poor records make it impossible to correlate the reflections of the marine survey with those observed in the good record area of the land survey approximately 12 miles inland. Intervals between reflection events observed in good record areas of both surveys are difficult to correlate and hence correlation of horizons mapped is not possible.

Lines 5 and 6 of the marine survey traversed the large gravity high anomaly in the Queens Channel, which was mapped by the Bureau of Mineral Resources sub-marine gravity survey as being centred at about shot point 610.

The gravity survey showed positive reversal of Bouguer gravity values of approximately 25 milligals between Pearce Point in the Port Keats area and the Keep River Inlet to the south. It had been postulated that the large gravity anomaly represented a basement high that could have formed a barrier to Palaeozoic deposition in the Bonaparte Gulf Basin between the Keep River and Port Keats areas. The Bouguer gravity values over the high

show a continuous rise to shot point 600, where the lower horizon still shows a reflection time of approximately 1.300 seconds. The lower horizon Horizon, 'B', rises approximately .300 seconds from shot point 550 to shot point 600. Between shot points 600 and 620, Horizon 'B' shows reversal of approximately .080 seconds and then rises again to the south-east to the end of Line 6. Horizon 'A' shows similar trends. Although this structural reversal near shot point 600 coincides with the crest of the gravity high, its magnitude is insufficient to account for the observed gravity reversal. Some scattered reflections occur in the second below the Horizon 'B' level in this area which appear to be conformable with the shallower section. No indication of a more pronounced structure at depth or any change in the general character of the reflection section that could explain the gravity anomaly is evidenced on the results of Lines 5 and 6.

It must be concluded that although the small reversal shown on Lines 5 and 6 may well be related to the gravity high anomaly, the major cause of the gravity anomaly must occur below the section mapped and that sedimentation, at least in part, was continuous across Queens Channel and it is likely that the Palaeozoic section occurring in the Keep River area would also occur in the Port Keats area.

LOCATION OF SHIP'S POSITION AND DETERMINATION OF SHOT POINT POSITIONS :

In order to predict accurately the time cycle at which shots should be fired to ensure the correct spacing between them, m.v. Laakanuki was anchored ahead and close to the line of traverse, to time a known length of the geophone cable as it passed her. The recording boat's speed was frequently determined by this method and used to adjust the time cycle as currents, winds and tides varied. Within sight of land the ship's position was fixed at each shot point by two or more magnetic bearings measured from the recording boat's standard compass to prominent topographic features such as Cape Hay and Mount Goodwin. Further to seaward the lines were shot from a previously fixed buoy position within sight of land, or from the Laakanuki anchored to act as a back sight, on a time cycle and compass course.

Buoys were dropped to position accurately the ties at all line intersections and to mark the position of a line at the end of a day's shooting.

At each shot, the ship's position, water depth, ship's head and cable deviation were tabulated. Cable deviation was read by sighting the cable from the stern by alidade and measuring the angle between the cable and the line of the ship's head. The convention adopted for fixing the

Commonwealth Topographic Survey Maps Nos. D52-7 and D52-11. The shot point was plotted 1615 feet behind the ship's position along the line of the true cable bearing (see Diagram 2).

The distance between shot points was 1320 feet and the straddle spread length was 1265-0-1265 feet.

The line of shot points relative to the ship's true course depended on currents, winds and tides and varied continually with them.

RECORDING :

A straddle spread technique consisting of 24 Gulf pressure hydrophones equally spaced at 110 foot intervals was employed. The hydrophones were suspended 10 feet below the surface of the water from a buoyant stress member to which the conductor cable was attached. The charge was detonated from a separate firing line between stations 12 and 13.

In order to eliminate extraneous noise arising from the motion of the hydrophones through the water, the recording cable was released a few seconds before the shot. This action also allowed the hydrophones to sink to their operational depth. Five seconds after the shot, the cable was wound in and held ready for the next shooting cycle. The whole cycle of events being performed automatically by a remote control unit.

The recording set up was as follows :-

1. 24 AAZ amplifiers (Filter settings H.P. 15 c/s; L.P. 65 c/s) whose output was split between -
   (a) DS8 Electro Tech Magnetic Tape Recorder.
   (b) DMD Unit (Filtered 17-55 c/s).

The low pass filter of 65 c/s was selected to afford partial compensation for the response of the pressure geophone which increases with frequency.

2. 15 transistorised amplifiers receiving their input signal from a set of monitoring heads on the DS8 recorder and with their outputs feeding a Visual Display Unit.

The DS8 is provided with 27 recording heads which were employed as follows -

Heads 1 - 24 - Geophone signals (Head No.1 recording the signal from the geophone nearest the ship).

Head 25 - 100 c/s timing signal.

Head 26 - Time break.

Head 27 - Trigger pulse for playback.

Continuous rolls of tape were used, varying in length between 200 and 500 feet. The tape speed was $7\frac{1}{2}$ inches per second and about $4\frac{1}{2}$ second of seismic information after the time break was recorded.

played by projection on to a perspex screen from conventional galvanometers.

The DMD Unit gave an instantaneous corrected time section with approximately 4½ seconds of information. Carriage speed was 4 inches/sec. using 12 signal channels 2, 4, 6, 8, 10, 12, 13, 15, 17, 19, 21 and 23.

SHOOTING :

The method used to locate the shot point midway between geophone stations 12 and 13 was as follows :-

The shooting launch steamed parallel with the geophone cable opposite and approximately 100 feet away from a marker buoy on the cable; this launch towed a 150 foot firing line with a cone buoy supporting its free end. The explosive charges (10/20 lbs. Geophex) were slung on rings which slid down the insulated firing line to the cone buoy. A section of the firing line near the cone buoy was not insulated and thus a circuit was made from the blaster to shooting cable to charge through a sea water return to the ship's hull and blaster. The blaster used was capacitive and, with a voltage of 1500-2000 volts, was sufficient to overcome the leakage and supply adequate volts at the end of the shooting cable to detonate the shot.

The depth of shot was 4-5 feet below the surface.

The shot was fired remotely by the interruption of a radio oscillator signal transmitted from the recording boat. Prior to the shot, this signal was demodulated and rectified by the shooter's radio and was used to "hold off" the blaster. The interruption of the oscillator signal was performed by remote control unit on the recording boat and the system gave rise to a constant 2 millisecond delay between the recorded time break and the detonation of the shot.

Some difficulty was experienced, especially at the start of the survey on Line 1, in positioning the shooting boat accurately so that the shots were detonated midway between geophones 12 and 13. This was mainly due to the throttle control on the shooting boat being situated on the engine itself, and the coxswain at the wheel being unable to make the necessary small adjustments in speed directly from the bridge. Either bubble or air shots would be likely to result from sudden changes in speed while endeavouring to position the shots accurately. These indicate that detonation of the charge has occurred either at too great a depth or too close to the surface respectively.

In the case of a "bubble" (for example, at shot point 447), successive expansion and contraction of the pocket of gas generated by the

When the charge is placed at the correct depth (4 - 5 feet) the first expansion of the gases will have just been completed at the moment the "bubble" breaks the surface.

PLAYBACK :

Variable Area Sections (VAX) were produced in Wyndham by playback from an Electro-Tech DS7 magnetic recorder through a second set of 24 AAZ amplifiers using half-section H.P. filters 15 c/s and single section L.P. filters 65 c/s. All tapes were played back unmixed.

When the tape was recorded on the DS8 recorder, the time break was fed to two heads, No.26 in line with the signal heads and No.27 displaced by a distance equivalent to 240 milliseconds. On playback through the DS7 recorder with all heads aligned No.27 track produced a pulse to trigger the VAX 240 milliseconds in advance of the time break which then was displayed on Trace 2. This procedure ensured that the time break and first breaks appeared on the VAX sections.

No static corrections were applied but all heads were corrected for the 2 millisecond time break delay referred to above under shooting.

One setting of dynamic correction was employed throughout the prospect.

Enclosure 22 illustrates filter comparison tests made on Line 2 to determine the optimum filter setting for playback.

Records incorrectly recorded, e.g. misfires, are marked 'X' on the VAX sections.

COMPUTING :

1. Elevation Correction.

The whole of the interpretation of this prospect is referred to a sea level datum. No elevation corrections have been applied since the combined depth of the charge and geophone was always less than 15 feet, leading to a maximum correction of less than 3 milliseconds.

2. Water Depth Correction.

No corrections for water depth have been applied. The water depth varied from 20 feet to 90 feet with an average of 60 feet. Assuming a water velocity of 5000 ft./second and an estimated near surface velocity of 7200 ft./second this leads to a maximum correction of 10 milliseconds and an average correction of less than 4 milliseconds.

3. Weathering Correction.

CONCLUSIONS :

The results of the survey were satisfactory and a rapid rate of progress was achieved.

The results have shown that the sedimentary section increases in thickness to the north-west and that the major basin development must occur west and north of the surveyed area.

The contour maps have defined a major anticlinal structure near the intersection of Lines 2 and 3 which may well show considerable closure further north-east outside the area covered by this survey.

Structural reversal was mapped near Shot Point 600 in Queens Channel which coincides with the crest of a large gravity high; however, the magnitude of the reversal is insufficient to account for the observed gravity anomaly and it is concluded that the major cause of the large gravity anomaly must occur below the section mapped.

Complete loss of sedimentary section across Queens Channel was not observed and hence it appears that sedimentation, at least in part, was continuous between the Keep River and Port Keats areas.

ENCLOSURES AND DIAGRAMS :

1. Enclosures.

No.1 -	VAX cross section	Line 1	shot points	1 - 42	
No.2 -	ditto.	1	ditto.	43 - 90	
No.3 -	ditto.	2	ditto.	91 - 131	
No.4 -	ditto.	2	ditto.	132 - 155	
No.5 -	ditto.	2	ditto.	156 - 185	
No.6 -	ditto.	2	ditto.	186 - 215	
No.7 -	ditto.	4	ditto.	325 - 372	
No.8 -	ditto.	4	ditto.	295 - 324	
No.9 -	ditto.	4	ditto.	272 - 294	
No.10 -	ditto.	4	ditto.	374 - 415	
No.11 -	ditto.	3	ditto.	216 - 271	
No.12 -	ditto.	3	ditto.	416 - 433	
No.13 -	ditto.	3	ditto.	434 - 473	
No.14 -	ditto.	3	ditto.	474 - 513	
No.15 -	ditto.	5	ditto.	514 - 536	
No.16 -	ditto.	5	ditto.	537 - 569	
No.17 -	ditto.	5	ditto.	570 - 610	
No.18 -	ditto.	6	ditto.	611 - 650	
No.19 -	ditto.	7	ditto.	717 - 742	
No.20 -	ditto.	7	ditto.	697 - 716	
No.21 -	ditto.	7	ditto.	651 - 696	
No.22 -	Filter comparisons	2	ditto.	206 - 211	
No.23 -	Location map - scale 4 miles to the inch				
No.24 -	Time contour map - Horizon A - Scale 1 mile = 1"				(northern sheet)
No.25 -	ditto.	ditto.	ditto.		(central sheet)
No.26 -	ditto.	ditto.	ditto.		(southern sheet)
No.27 -	ditto.	- Horizon B -	ditto.		(northern sheet)
No.28 -	ditto.	ditto.	ditto.		(central sheet)

3. Diagrams.

No. 1	Ship's head, True Course, Compass Error, Cable deviation diagram
No.	Geophone cable disposition.
No. 3A	Filter Curves AAZ Amplifiers for Record and Playback.
No. 3B	Equipment.
No. 4	Filter Curves for DMD Amplifiers.
No. 5	Combined response curve of GCF pressure hydrophones and AAZ amplifier.

APPENDIX "A"

STATISTICS WITH LIST OF PERSONNEL AND EQUIPMENT INCLUDING CRAFT.

STATISTICS :

No. of days at sea	-	9
No. of days shooting	-	6
No. of days travel	-	3
Coverage in miles	-	185
No. of shots fired	-	742
No. of shots per shooting day	-	124
Total hours worked	-	$86\frac{1}{2}$
Hours recording	-	$38\frac{3}{4}$
Hours travelling	-	$47\frac{3}{4}$
Hours lost due to breakdown of equipment or vessels	-	Nil.
No. of misfires	-	18
Geophex used	-	14,000 lbs.
Detonators used	-	750

Field Personnel.

Mines Administration Pty. Limited field representative	-	J.E. Burbury
Party Chief	-	R.D. Lugg
Chief Computer	-	E.J. Bassett
Computer/Playback Operator	-	N.J. Delaney
Observer	-	A.R. Edgington
Assistant Observer	-	P.A. Watson
Surveyor	-	J.E. Rogers
Shooter	-	R.A. Hennings
Shooter	-	R. Kilby

Vessels Used During the Survey.

m.v. "Tamona" - Landing craft type barge 35 tons with 2 x 5 cylinder Gardner diesel engines, draught 4 feet, was used as recording boat.

m.v. "Zena" - 45 foot launch was used as shooting boat.

m.v. "Laakanuki"- Fishing vessel, 300 tons, length 120 feet, draught $8\frac{1}{2}$ feet, was used as mother ship to accommodate and mess the seismic personnel.

Recording Equipment Used.

AAZ Amplifiers -

Gain of 120 dB from 500 ohm input to output plate.
Frequency range from 25 to 105 c.p.s. filtered and from 3.5 c.p.s. in the refraction position.
High pass filters of 25, 35, 45, 65 c.p.s.

APPENDIX "A" (Contd.)

AAZ Amplifiers (Contd.)

Short and normal A.G.C. speeds.
Suppression of 50 dB by one master control.

G.C.F. Gulf Pressure Geophones -

Frequency response (at a depth of 2 feet), rising with frequency at the rate of 6 dB/octave.
Output of 104 dB below 1 volt per dyne per square centimetre at 125 cycles per second.

Electro-Tech DS-7 Tape Recorder -

Signal to noise ratio greater than 46 dB r.m.s. to r.m.s. at peak magnetisation, 30 c.p.s.
Static time correction of ± 50 milliseconds.
Maximum dynamic time correction of 100 milliseconds.
Maximum correction rate of 300 milliseconds per second.
Overall timing accuracy of ±0.5 millisecond.
Head spacing of .250 inch.
Track width of .140 inch.
Tape speed of 7½ inches per second.
Tape width of 7½ inches.

Electro-Tech DS-8 Tape Recorder -

Similar to the DS-7 recorder, but lacking facilities for static and dynamic time corrections.

Variable Area Cross Section Recorder -

24 variable area traces at a time on 9½" film.
Image width of all 24 traces is 2/3"
Timing marks at 0.1 sec. intervals are recorded before and after each section.

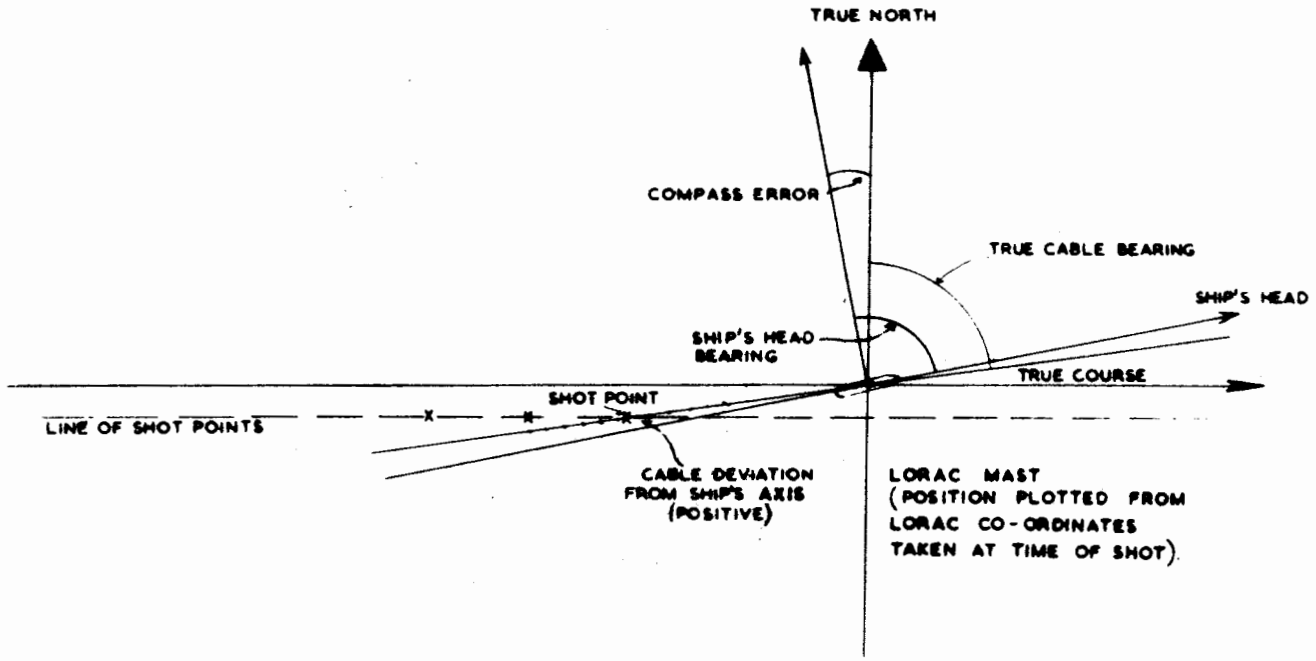

TRUE NORTH
COMPASS ERROR
TRUE CABLE BEARING
SHIP'S HEAD
SHIP'S HEAD BEARING
TRUE COURSE
SHOT POINT
LINE OF SHOT POINTS
CABLE DEVIATION FROM SHIP'S AXIS (POSITIVE)
LORAC MAST (POSITION PLOTTED FROM LORAC CO-ORDINATES TAKEN AT TIME OF SHOT).

DIAGRAM 1

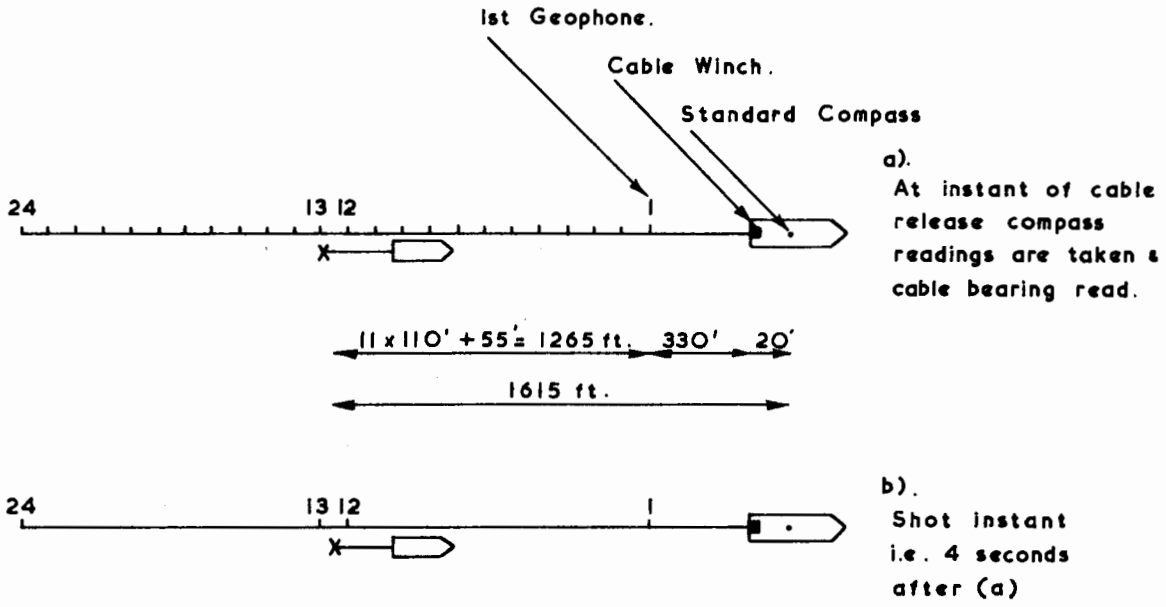
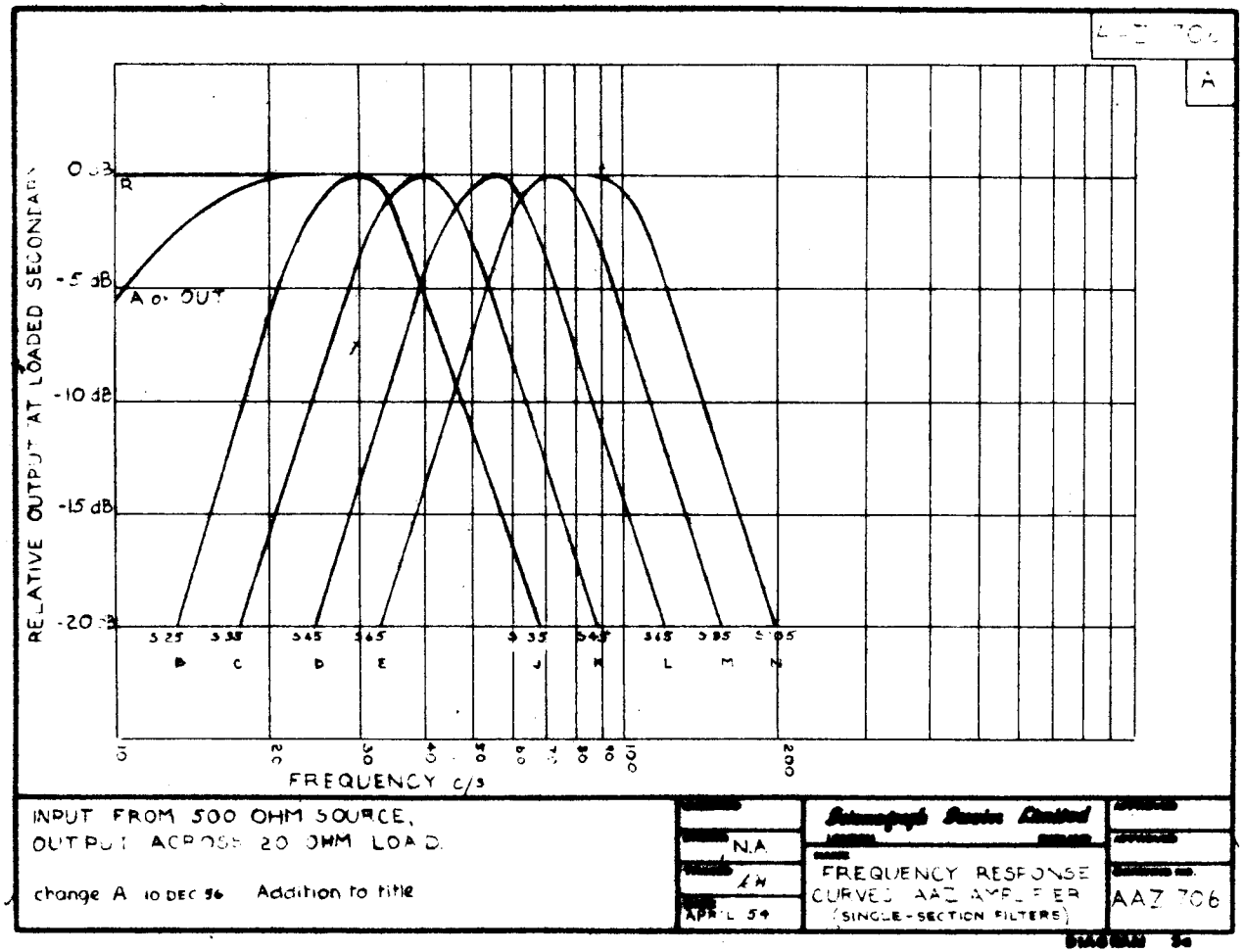
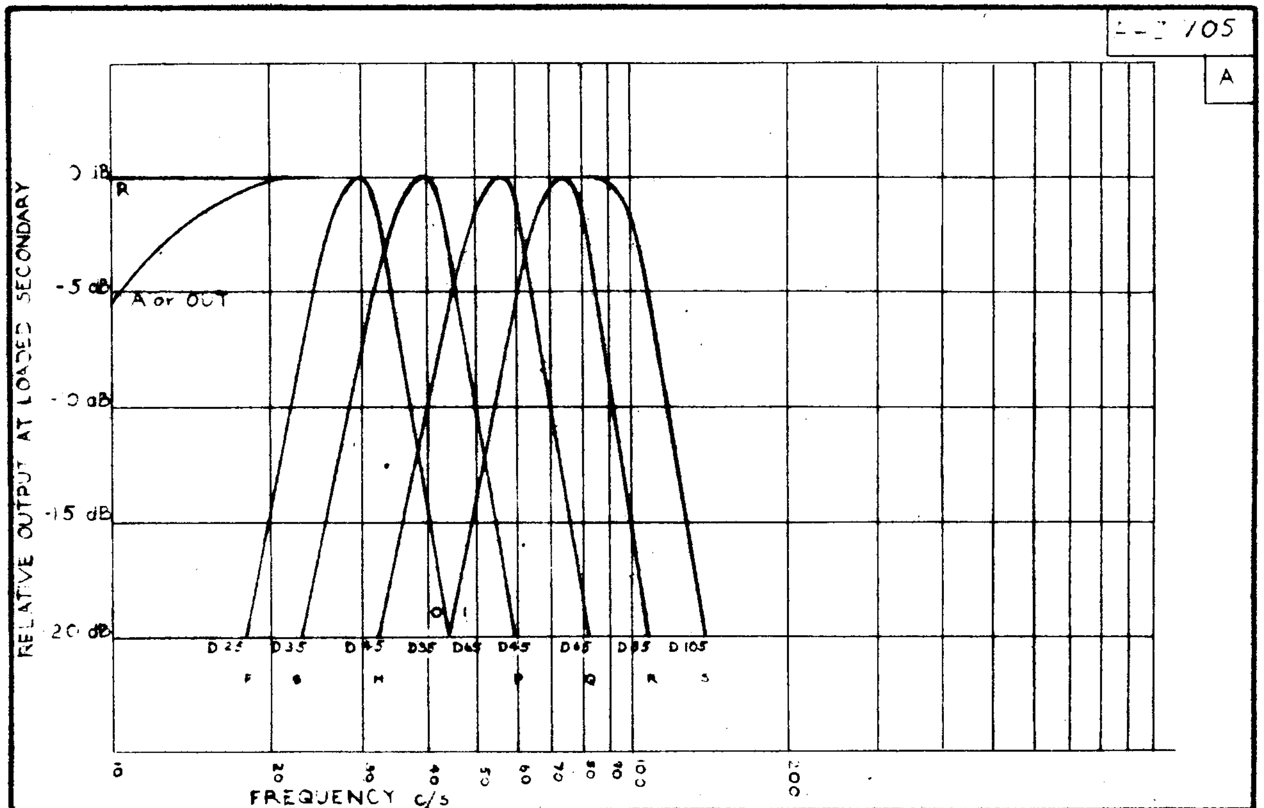

1st Geophone.
Cable Winch.
Standard Compass
24
13 12
1
a).
At instant of cable release compass readings are taken & cable bearing read.
11 x 110' + 55' = 1265 ft.
330'
20'
1615 ft.
24
13 12
1
b).
Shot instant i.e. 4 seconds after (a)

DIAGRAM 2


A
0 dB
-5 dB
-10 dB
-15 dB
-20 dB
RELATIVE OUTPUT AT LOADED SECONDARY
A o/p OUT
B
C
D
E
J
K
L
M
N
FREQUENCY c/s
INPUT FROM 500 OHM SOURCE,
OUTPUT ACROSS 20 OHM LOAD.
change A 10 DEC 56 Addition to title
N.A
APRIL 54
FREQUENCY RESPONSE
CURVES AAZ AMPLIFIER
(SINGLE-SECTION FILTERS)
AAZ 706



INPUT FROM 500 OHM SOURCE.
OUTPUT ACROSS 20 OHM LOAD

Change A 10 DEC 56 Addition to title

N A

APR 54

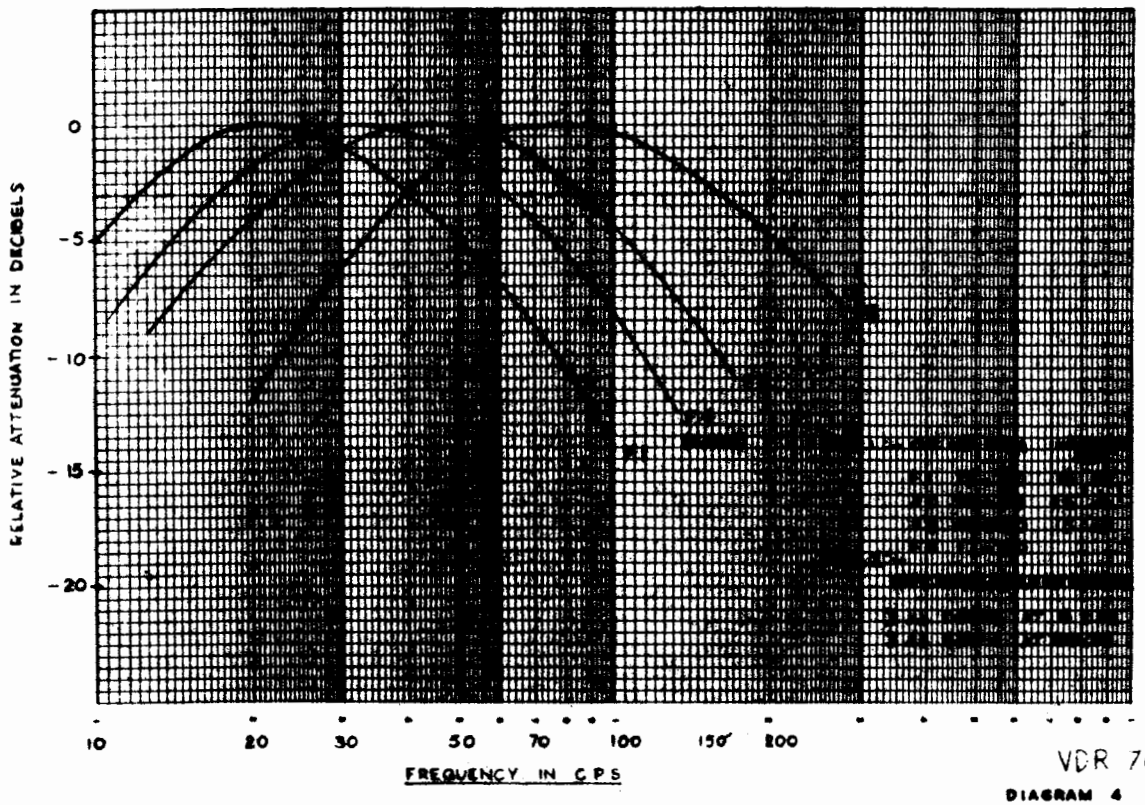
FREQUENCY RESPONSE
CURVES AAZ AMPLIFIER
(DOUBLE-SECTION FILTERS)

AAZ 735

DIAGRAM 35

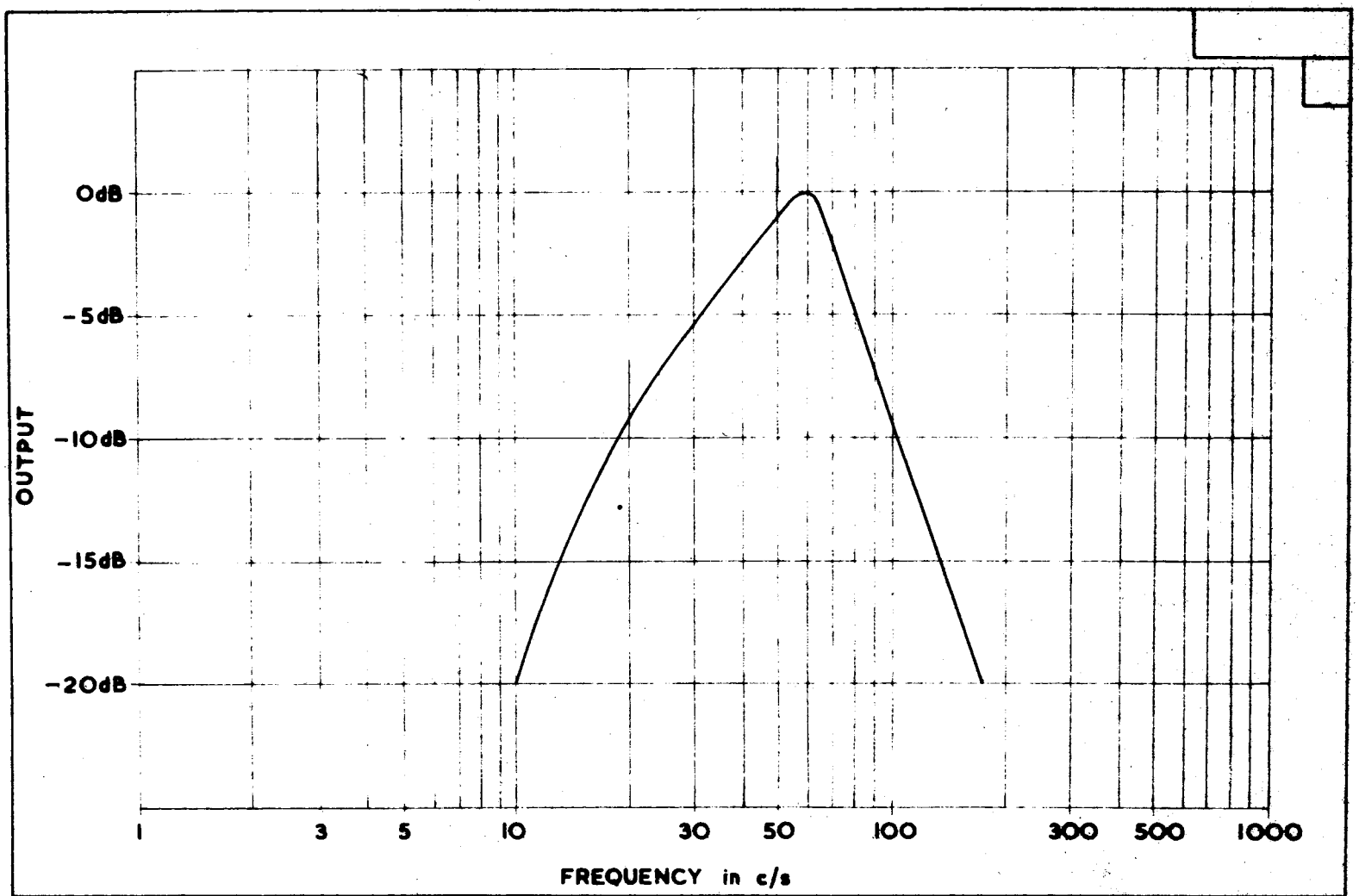
CHANGE A. 2 JUNE 59. F4 (MARINE) ADDED [redacted] 17 TH FEB. 1959. VDR 701 A

LIMITED ADDITIONAL FILTERING FOR DMD AMPLIFIER



VDR 701 A

DIAGRAM 4



0dB ≡
INPUT:
OUTPUT:

CURVE FOR SGS HYDROPHONE BASED ON CALIFORNIA RESEARCH TESTS

Seismograph Service Limited
LONDON ENGLAND

DATE	DRAWN
CHECKED	TRACED

NAME
COMBINED RESPONSE CURVE FOR AAZ AMPLIFIER (½ SIS S65) & GCF GULF PRESSURE HYDROPHONE

DIAGRAM 5