051001

Bass Basin part VII

BASS EF-68 MARINE SEISMIC SURVEY

FINAL SUBSIDY REPORT

BY

N.C. HIGGINS

Esso Standard Oil (Australia) Ltd.
Sydney, N.S.W. Australia
December 1968

OR-007

ABSTRACT

The Bass Basin covers an area of 25,000 square miles and is located between the Australian mainland and Tasmania. It is bounded on the east by the Bassian Rise and on the west by the King Island-Mornington High.

Deposition was initiated in the area sometime prior to Upper Cretaceous and before basin inception. The basin began to form in the Upper Cretaceous with gentle subsidence accompanied by an en echelon system of normal basement faulting. Upthrown basement fault blocks remained as stable areas which resulted in most of the local structure presently in Bass. General subsidence continued throughout the Tertiary and was greatly accelerated during Lower Miocene.

The lithology and origin of Pre Upper Cretaceous sediments in the area are presently unknown. Continental deltaic deposition prevailed from Upper Cretaceous to Upper Eocene. Near the close of the Eocene, the seas transgressed to the east and marine sediments were deposited during the remainder of the Tertiary.

The Bass EF-68 Seismic Survey has defined two structures, a stratigraphic prospect, and has slightly altered previous concepts regarding the geologic history of the basin.

TABLE OF CONTENTS

ABSTRACT

LIST OF ILLUSTRATIONS

INTRODUCTION

OBJECT OF SURVEY

INTERPRETATION

Generalized Geologic History

Horizons Mapped

Areas Mapped

CONCLUSIONS

APPENDICES

A. Field Operations Report

B. Data Processing Procedures

C. Bass Basin - Generalized Time Vs. Depth Chart

LIST OF ILLUSTRATIONS

FIGURE I	-	LOCALITY MAP
FIGURE II	-	LOCAL STRUCTURE MAP ON UPPER CRETACEOUS
PLATE I	-	STRUCTURE MAP ON OLIGOCENE
PLATE II	-	STRUCTURE MAP ON EOCENE
PLATE III	-	STRUCTURE MAP ON BASEMENT

VARIABLE DENSITY SECTIONS (TWO (2) COPIES OF EACH)

Bass EF 68 Seismic Survey Lines		Digitally Reprocessed Data Lines	Shot Points
EF-27	EF-90	B-10	6A-1; 1001-1089
EF-33	EF-91	B-10	363 - 318A
EF-52	EF-92	B-20	201 - 81
EF-73	EF-93	B-22	1 -50
EF-76	EF-94	ES-40	7546 - 7598
EF-85	EF-95	ES-46	7190 - 7254
EF-86	EF-96	ES-55	8590 - 8787
EF-87	EF-97	ES-56	8865 - 9090
EF-88	Ef-98	ES - 62	9264 - 9423
EF-89		ES -63	9092 - 9133
		ES-74	1850 - 1929
		ES-79	7299 - 1683

T Delta T Velocity Gathers (two (2) copies of each)

Line EF 94	Shot points:	1170, 1176, 1182, 1197, 1203, 1209, 1263, 1269, 1275, 1473, 1479, 1485 1548, 1554, 1560
Line EF 95	Shot points:	1631, 1637, 1643, 1697, 1703, 1709, 1793, 1799, 1805, 1844, 1850, 1856, 1874, 1880, 1886

INTRODUCTION

The Bass EF-68 Seismic Survey was carried out for Esso Exploration Australia Inc. by Western Geophysical Company. The survey covered four areas, which are located in Tasmania Petroleum Exploration Permits T/3P, T/4P, T/5P and T/6P. Field work commenced June 27, 1968, and was completed August 11, 1968. A total of 389.58 miles of Aquapulse common depth point data was recorded. In addition to the new survey, 293.5 miles of six-fold and single fold analog data was reprocessed digitally.

OBJECT OF SURVEY

The 1968 seismic program was designed to obtain detailed control over two structural leads and a stratigraphic prospect. Another objective of the survey was to reconnoitre an interesting area in the southeastern portion of the basin, previously controlled by single fold analog data, with the common depth point technique.

INTERPRETATION

General interpretation of the Bass Basin has been based largely on regional single fold seismic lines and rather localized six fold common depth point data. The information derived from the last seismic survey has been very useful and has changed previous local and regional interpretation.

Generalized Geologic History - The Bass Basin developed on the southern end of the Paleozoic Tasman Geosyncline. This broad trough extended from Northern Queensland through Tasmania and farther onto the southeast. More than 40,000 feet of sediments were deposited and subjected to several periods of complex folding and faulting accompanied by local volcanism and metamorphism. This sequence of rocks is probably the main source of Cretaceous and Tertiary sediments later deposited in the Bass Basin.

Prior to Cretaceous time, basement was consolidated in the Bass area. The age of basement rocks is postulated to vary from Precambrian to Triassic. The positive area forming the north and east flank of the basin is predominantly granite. The south and west flank is mainly composed of metamorphic rocks of varying grade.

During Lower Cretaceous time, a large regional syncline began to develop in an east-west direction over an area which now includes the Otway, Bass and Gippsland basins. It is well known that several thousand feet of Lower Cretaceous greywackes and sub-greywackes were deposited in the Gippsland and Otway basins, but until the advent of recent seismic data the oldest sedimentation in Bass was believed to be Upper Cretaceous in age. It is now postulated that, at least in the southeastern part of the basin, more than 5000 feet of pre-Upper Cretaceous sediments were deposited before basin inception. This deposition is probably Lower Cretaceous in age.

The Bass Basin began to form during the Upper Cretaceous. Gentle subsidence was initiated along with large scale, normal basement faulting. These faults have a dominant northwest-southeast trend and are probably extensions of a similar fault system in northern and central Tasmania. Continental deposits began with the Upper Cretaceous and prevailed to Upper Eocene. This section generally, is a deltaic-complex composed of interbedded sandstone, siltstone, shale and coal. The source of the Upper Cretaceous basin infill was the Precambrian and younger metamorphics on the south and west sides of the basin.

Gentle regional subsidence continued during Paleocene and Eocene while basement faulting was sharply attenuated. Northeastern Tasmania was a positive area and shed the bulk of the clastic sediments during this period. Local unconformities were prevalent throughout this period of sedimentation. The Esso Bass 2 indicates a large unconformity occurred near the end of the Middle Eocene. Upper Eocene was marked by the occurrence of widespread adjustment faulting in the sedimentary cover of the basin. Near the end of the Upper Eocene there was a transition from continental to restricted marine deposition as the seas transgressed to the east. Marine shales were deposited conformably over shallow water sandstones, which overlaid continental sands, shales, and coals. Eocene deposition transgressed the west flank of the basin over the King Island-Mornington High.

During the Oligocene, basin subsidence and marine transgressive deposition continued. The sediments are composed of shale, mudstone with small amounts of sand and volcanics. The volcanics were deposited mostly in the central and western part of the basin near the end of the Oligocene.

Subsidence greatly accelerated during the Miocene and marine deposition continued with some volcanic activity. Over 4000 feet of Miocene and younger sediments were deposited as the basin began to assume its present shape. Vertical movement of the older Upper Cretaceous fault blocks was slightly rejuvenated resulting in most of the present Tertiary structure in the basin. The King Island-Mornington High experienced its last period of movement during the early Miocene. The late Miocene seas completely transgressed the Bassian Rise to the east and this was the first deposition across the divide between the Bass and Gippsland Basins.

A thin veneer of Quarternary sediments cover the Tertiary deposits.

Horizons Mapped - Maps drawn over the four areas covered by this report have been integrated with three regional maps previously submitted. The maps are based on the top of the Oligocene, top of the Eocene and top of Basement. Also, included in the report is a local map covering a deep prospect and based on the approximate top of the Upper Cretaceous.

Areas Mapped - The Bass EF-68 Survey covers four different local areas in the basin. For the convenience of communication and in an effort to be consistent with the Gippsland and Otway Basins, each area of interest has been given the name of an aquatic bird.

Frigate - This anomaly is located on the southwestern flank of the basin. It is expressed on the Eocene horizon as a relatively small, low relief anticline that trends in a southwest-northeast direction. The structure has an area of approximately 15 square miles and 150 feet of vertical closure. Structural closure is not present on the top of the Oligocene horizon. The structural history of Frigate closely resembles that of the anomalies drilled by the Bass 2 and Bass 3 wells. The feature is a result of a rather complicated horst block that occurred in the basement rocks during the Upper Cretaceous. The upthrown basement block remained stable but relatively inactive until Oligocene time when it registered its greatest period of growth. Economic basement is approximately -7000 feet over the crest of the structure. Delta plain megafacies probably make up the Upper Cretaceous section at Frigate. The Paleocene and Eocene section should be more marine than that tested by Bass 3.

Two attributes of Frigate detract from its prospective potential. The small size of the structure and its similarity to the dry structures drilled by Bass 2 and Bass 3.

Pelican - This feature, located on the southwest flank of the basin, is a large, east-west trending anticline. Near the top of the Upper Cretaceous horizon the structure appears to have an area of about 60 square miles and vertical closure of 600 feet. The Upper Cretaceous structure map is based on a discontinuous seismic event that cannot be absolutely correlated throughout the area or tied to well control. Definite delineation of the structure is difficult, however, information derived from deeper reflection segments confirms the presence of a large anticline. Pelican had most of its structural growth during the Upper Cretaceous and early Tertiary. A local unconformity occurred sometime near middle Eocene and eroded the anticlinal crest. This unconformity marked the end of structural movement. Closure is not evident in the Upper Eocene. Normal faulting is apparent in the Upper Eocene and Oligocene sections. The downward extension of these faults cannot be traced because of poor reflection quality. A basement reflection is not evident below the Pelican structure, but it is predicted that basement is deeper than -12,000 feet. Pelican is considered the most unique structure discovered thus far in the basin because of its size and early period of structural growth.

Penguin - This stratigraphic prospect is located high on the northeast flank of the basin. This has been a positive area throughout Tertiary time. Successively younger Tertiary bids onlap shallow basement and only the Upper Miocene extends to the northern limits of the area. Basement slope has always been very gentle as evidenced by the gradual thinning of beds and the many shallow depositional pockets observed on the seismic sections. The Eocene sand reflection can be traced onto shallow basement but the overlying Upper Eocene siltstone may grade updip into a sandy facies and would not effect a hydrocarbon trap.

This situation is indicated by lateral changes in reflection count and character through the Upper Eocene, Oligocene and Miocene sections. The potential of this area will be difficult to evaluate until well control is added on shallow basement.

Heron - This name refers, for the present, to the large area of 2000+ square miles in the southeastern end of the Bass Basin. Only regional seismic lines have been shot, therefore individual prospects have not been delineated. Seismic lines EF-94 and EF-95 are the first common depth point digital control obtained in this area of the basin. These data have more resolution and reveal much deeper information than the previous single fold analog coverage. Heron is a faulted and folded complexity with a sedimentary section that ranges deeper than 20,000 feet. Accurate age dating of the deeper section is presently impossible with the limited amount of good seismic control, however, extensive interval velocity calculations have been made to basement and assures that it is a sedimentary section. The interval velocities range to 12,000 feet per second at maximum depth. Major faults in the area have a vertical displacement in excess of 10,000 feet. They trend from southeast to northwest and are probably part of the more minor fault system previously mapped along the northern flank of the basin. Many types of prospective leads are apparent on the new seismic data. These include compressional and gravity folding, angular and sub-angular unconformities, drape over upthrown fault blocks, and stratigraphic pinch outs. More regional and detailed seismic work is required to fully evaluate this area.

CONCLUSIONS

The Bass EF Seismic Survey accomplished the objectives. The two structural anomalies were adequately defined. The Pelican anomaly is the most prospective single feature discovered in the basin. The seismic work over the stratigraphic lead has certainly enhanced our knowledge of the area, but the prospect may remain an undefined value until a well is drilled for facies control. The new seismic coverage in the southeastern part of the basin may have been the most important contribution of the survey. This large area, has an unlimited potential and will require much more common depth point seismic control.

The data quality of the EF Survey ranged from good to very good and was reliable throughout. The improvement of the latest seismic information was particularly notable in the Heron area.

APPENDIX A

051009

FINAL OPERATIONS REPORT

AUSTRALIA MARINE SEISMIC SURVEY

BASS EF-68

FOR

ESSO STANDARD OIL (AUSTRALIA) LTD.

BY

WESTERN GEOPHYSICAL COMPANY OF AMERICA

PARTY 64

JUNE - AUGUST, 1968

TABLE OF CONTENTS

		Page
I.	SUMMARY	1
II.	GENERAL INFORMATION	1
	A. Contractors	1
	B. Base of Operations	1
	C. Weather	1
	D. Surveying Technique	2
	E. Chronology	2
III.	RECORDING OPERATIONS	3
	A. Major boat equipment	3
	B. Instrumentation	3
	C. Detector cable	4
	D. Recording Technique	4
IV.	DATA PRESENTATION	5
	A. Field	5
	B. Processing	5
	C. Final Interpretation	6
V.	KEY FIELD PARTY PERSONNEL	6
	A. Esso Standard Oil (Australia) Ltd.	6
	B. Western Geophysical Company of America	6
	C. Offshore Navigation, Inc.	6
VI.	STATISTICAL SUMMARY	7, 8

PLATES

I. Location Map
II. 7590 foot Cable Diagram
III. 5290 foot Cable Diagram

APPENDIX

General Description and Specifications DFR-300 Binary Gain Seismic System

I. SUMMARY

A continuous reflection seismic survey using the AQUAPULSE system was conducted in the Bass EF-68 area, offshore Tasmania, Australia. Operations commenced on June 27, 1968 and were completed on August 11, 1968.
Refer to Plate I for detailed location of survey lines.

II. GENERAL INFORMATION

A. Contractors

The survey was conducted by Western Geophysical Company of America, 933 North La Brea Avenue, Los Angeles, California, and 69 Berry Street, North Sydney, New South Wales, Australia. Positioning control was provided by Offshore Navigation, Incorporated, 5728 Jefferson Highway, New Orleans, Louisiana and 159 Bunnerong Road, Kingsford, New South Wales, Australia.

B. Base of Operations

Headquarters for the Bass EF-68 area were set up in Devonport, Tasmania. Good harbour facilities, twice weekly ferry services and a daily air service were available. Its central position, good communications and supply source, made Devonport an excellent base for operations.

C. Weather

The weather was consistently bad; a total of 28 days out of 55 spent in the Bass EF-68 area, were lost directly due to rough seas.

D. Surveying Technique

The SHORAN direct ranging method was employed for positioning control. The equipment included track plotter and digital print out system.
The Prospect consisted of four individual nets for which seven land based stations had to be used.
A description of the SHORAN system and fixed base station sites is included in a separate report to be submitted by Offshore Navigation, Incorporated.

E. Chronology

June 17, 1968 : Departed Gippsland area for Bass EF-68 area.

June 18, 1968 : Anchored down on Prospect. No Shoran signals. Proceeded to Devonport to shelter from rough seas.

June 21, 1968 : Departed Devonport for Prospect.

June 22, 1968 : Sheltered at King Island.

June 27, 1968 : Commenced recording - lines EF-89, 90, 91.

June 28, 1968 : Proceeded to Devonport to shelter and fit new Shoran pre-amp and low coaxial cable.

July 2, 1968 : Resumed recording - line EF-92. Proceeded to Devonport to shelter.

July 6, 1968 : Resumed recording - lines EF-93, 88, 33, 86, 87, 85.

July 8, 1968 : Completed King Island - Three Hummock Island nets. Picked up Shoran Station from King Island. Proceeded to Devonport.

July 9, 1968 : Cable length reduced to 1600 meters.

Standing by for new Power Convertor unit from U.S.A.

July 20, 1968 : Departed Devonport to balance cable.

July 21, 1968 : Returned to Devonport to shelter and work on cable.

July 23, 1968 : Resumed recording - line EF-94.

July 24, 1968 : Returned to Devonport to shelter and work on cable.

July 29, 1968 : Resumed recording - line EF-95.

July 31, 1968 : Returned to Devonport to shelter.

August 7, 1968 : Resumed recording - lines EF-52, 73, 96, 27, 76, 97.

August 10, 1968 : Sheltering at Deal Island.

August 11, 1968 : Resumed recording - line EF-98. Bass EF-68 area completed.

III. RECORDING OPERATIONS

A. Survey Vessel: M/V "Western Spruce" - 119 feet steel hull twin-screw vessel of American registry, powered by two General Motors V-16 Marine Diesel engines, capable of 11 knots cruising speed, and fitted with two Decca 202 Radar, Raytheon fathometer, and Apelco ship-to-shore radio.

B. Instrumentation

Digital Recorder - SDS 1010, 30-channel, 9-track, IBM compatible, EPRCO preferred, $\frac{1}{2}$ inch gapless tape format, binary gain controlled amplifiers.

On-board Display - Raytheon Precision Depth Recorder, driven by output of trace 22, through a TFA-1 amplifier.

Magnetometer - Varian Proton Marine

Magnetometer, Model V-4937.

C. Detector Cable

A neutrally-buoyant oil-filled streamer cable equipped with four depth detectors, three special water break detectors, and 24 seismic detector groups was used. Each seismic detector group was 230 feet in length and consisted of 20 crystal geophones.

The 7590 foot cable consisted of dead sections 100 feet in length separating each "live" group, giving a group centre spacing of 330 feet. Refer to Plate II. While recording with the 7590 foot cable, the buoyancy was adjusted so that it ran at an average depth of 45 feet, and depth was maintained by eight CONDEP pressure cable depth controllers, to plus or minus 7 feet. On July 9, the cable length was reduced to 5290 feet for the remainder of the survey by removing the 100 feet dead sections. While recording with the 5290 foot cable, the buoyancy was adjusted so that it ran at an average depth of 40 feet.

D. Recording Technique

With the AQUAPULSE system, four "guns" in a rectangular array were trailed at a depth of about 30 feet. The gun pulse monitoring system was used in conjunction with MP-8 Geospace phones and 300 Hz galvos.

Tests were made to ascertain the optimum gas pressure and fill time in order to obtain as near as possible a 3:1 gun pulse ratio of the first positive peak to the second. The pressures decided on were Oxygen 50lb. sq. in., Propane 22lb: sq. in. with a fill time of 1.5 seconds.

Under continuous-tow operations, the metered oxygen/propane mixture was fired electrically at intervals such that when recording with the 7590 foot cable, four pulses per 330 feet, or approximately 64 pulses per mile were produced. When recording with the 5290 foot cable, 3 pulses per 230 feet, or approximately 70 pulses per mile were produced. These pulse densities allow certain options in so-called vertical summing and horizontal stacking, such as 4-sum 12-stack or 8-sum 6-stack, and 3-sum 12-stack or 6-sum 6-stack. Refer to Plates II and III for a detailed diagram of the streamer cable, AQUAPULSE gun array, and navigation antenna - gun array - cable relationship.

IV. DATA PRESENTATION

A. Field

A variable density section was made by recording the output of group 22 on the Raytheon Precision Depth Recorder. It was found that the vertical to horizontal exaggeration was about 5 to 1 recording single pops. Wiggly trace, read-after-write monitors were produced by a Dri-Write camera every 8 pulses, or 660 feet. This monitor displayed data from the 24 seismic data channels, time break, individual gun pulse signatures, and direct water arrivals to the three water break detectors. A separate Dri-Write camera displayed, in graphic form, cable depth measured by the four depth detectors.

B. Processing

The digital tapes were air-shipped to Geophysical Service International, St. Leonards, for Processing.

C. Final Interpretation of the data was performed by Esso, Sydney.

V. KEY FIELD PARTY PERSONNEL

A. Esso Standard Oil (Australia) Ltd.

Name	Position
A. Martens	Client Representative
I. Criss	Client Representative
R. Stone	Client Representative

B. Western Geophysical Company of America

Name	Position
J. Hall	Operations Manager
D. Bailey	Assistant Operations Manager
P. Cooper	Co-ordinator
A. Shirley	Instrument Supervisor
R. Stansbury	Observer-Digital Operator
R. Adams	Gun Captain
V. Smith	Supervisor

C. Offshore Navigation, Inc.

Name	Position
I. Easterbrook	Party Chief
D. Hackenbruck	Mobile Operator
H. Adams	Mobile Operator

VI. STATISTICAL SUMMARY

A. Subsidised Area

(a) Tasmania.

1. Cable length - 7590 feet.

Line length measured from first to last Shoran position.

Constants:

1 interval	- 0.1243 miles plus 330 feet - 0.0621 miles
Centre guns to centre group 24	- 960 feet
Shoran antenna to centre guns	- 50 feet
Pop rate	- 4 per 330 feet
Record length	- 6 seconds

Line	SP - SP	Profiles	Statute Miles
EF 89	1 - 90	90	11.12
EF 90	91 - 184	94	11.62
EF 91	185 - 285	101	12.49
	Record length	- 7 seconds	
EF 92	286 - 406	121	14.98
EF 93	407 - 537	131	16.22
EF 88	538 - 728	191	23.68
EF 33	729 - 844	116	14.36
EF 86	845 - 915	71	8.76
EF 87	916 - 1010	95	11.75
EF 85	1011 - 1061		
	1050A- 1079	69	8.51
		Total Mileage:	133.49

2. Cable length - 5290 feet.

Line length measured from first to last Shoran position.

Constants:

1 interval - 0.0863 miles plus 230 feet - 0.0432 miles

Centre guns to centre group 24 - 655 feet

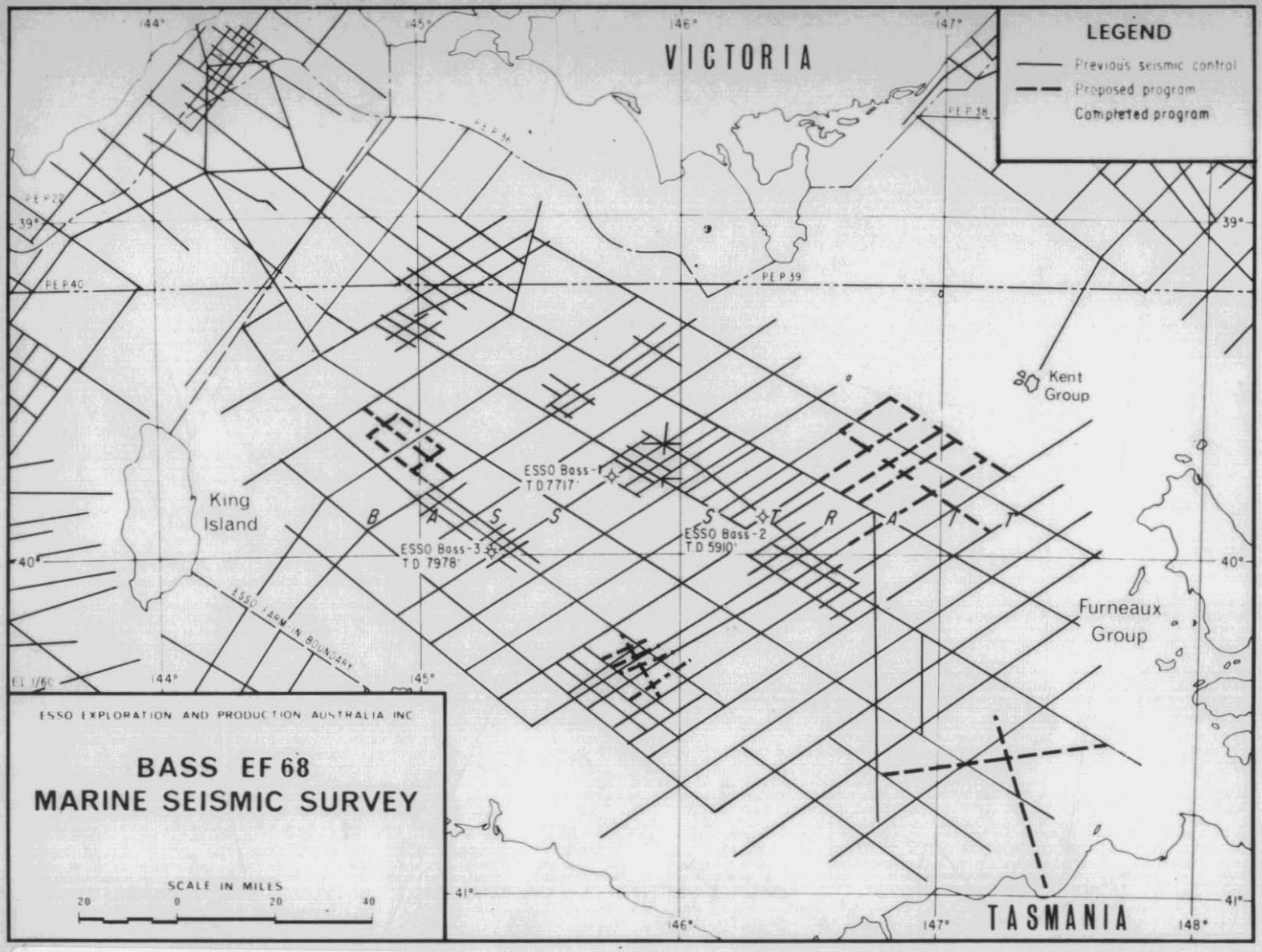
Pop rate - 3 per 230 feet

Record length - 5 seconds

Line	SP - SP	Profiles	Statute Miles
EF 94	1080 - 1388		
	1375A- 1618	539	46.47
EF 95	1619 - 1910	292	25.16
EF 52	1911 - 2297	387	33.35
EF 96	2298 - 2565	268	23.09
EF 73	2566 - 2842	277	23.86
EF 27	2843 - 3121	279	24.03
EF 76	3122 - 3269	148	12.73
EF 97	3270 - 3608	339	29.21
EF 98	3609 - 4051	443	38.19
		Total Mileage:	256.09

Bass EF-68 Area Total Mileage: 389.58

051019



ESSO EXPLORATION AND PRODUCTION AUSTRALIA INC

BASS EF 68
MARINE SEISMIC SURVEY

SCALE IN MILES
20 0 20 40

5 cm

PLATE I

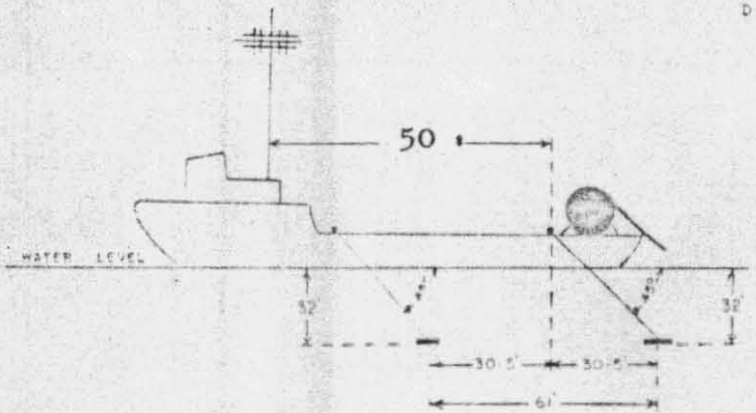
051020

ESSO
SEISMIC SURVEY
1968

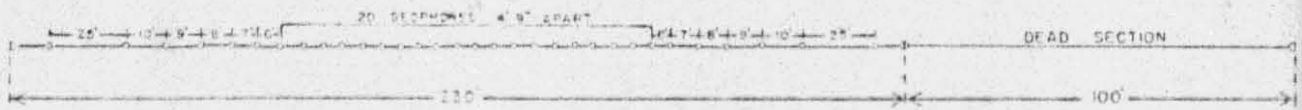
DIAGRAM OF 7590 Ft. STREAMER CABLE

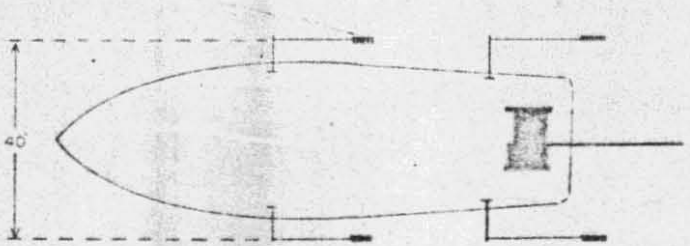
22 STRETCH SECTION

WB = WATER BREAK GEOPHONE
D = DEPTH DETECTOR



DETAIL OF NOISE CANCELLING ARRAY





THE AQUAPULSE SYSTEM

WESTERN GEOPHYSICAL
DIVISION OF LITTON INDUSTRIES

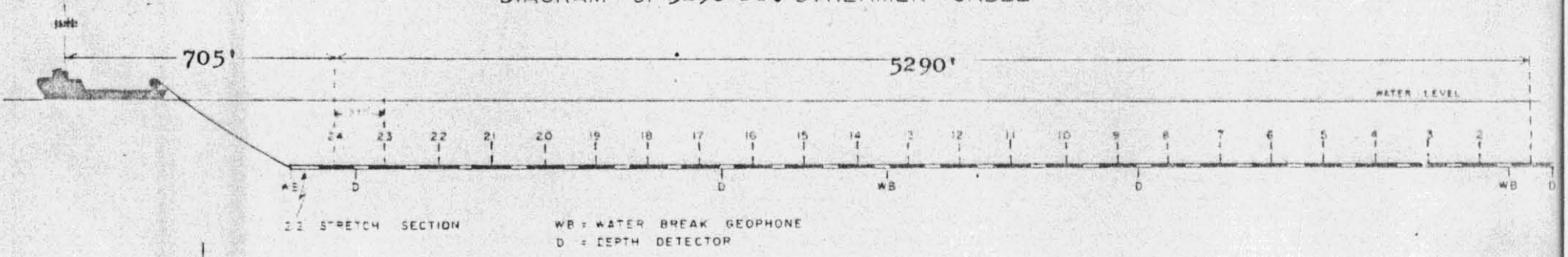
5 cm

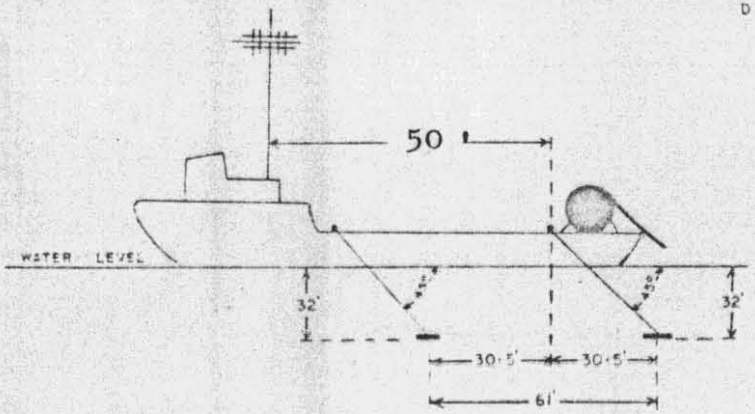
PLATE II

051021

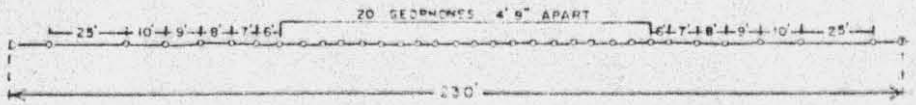
ESSO
SEISMIC SURVEY
1968

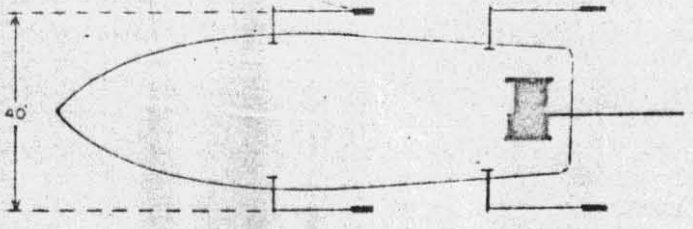
DIAGRAM OF 5290 FT. STREAMER CABLE





DETAIL OF NOISE CANCELLING ARRAY





THE AQUAPULSE SYSTEM

WESTERN GEOPHYSICAL
DIVISION OF LITTON INDUSTRIES

5 cm

PLATE III

GENERAL DESCRIPTION and SPECIFICATIONS

DFR-300 BINARY GAIN SEISMIC SYSTEM (HIGH GAIN)

1. General Information

1.0 Function

1.0.0 The DFR-300 Binary Gain Seismic System accepts data directly from the seismic sensors, conditions the data, and causes the conditioned data to be recorded on digital tape. At the option of the operator, either an analog oscillograph monitor record can be recorded in the read-after-write mode concurrently with the digital recording, output from the amplifiers can be monitored directly, or else selected files can be played back at some later time.

1.0.1 The basic 9-track format is described in Savit, "A proposed standard format for nine-track digital tape", published in Geophysics, v 31, n 4, 1966.

1.1 Physical Description

1.1.1 The recording system consists of seven sections as follows:

1. Input and Test Panel
2. Binary-Gain Input Amplifiers
3. Master Control Panel
4. Magnetic Tape Unit
5. Playback Amplifiers
6. Camera
7. Power Converter

1.2 Input and Test Panel

1.2.1 Included with the input and test panels are bridling switches, cable leakage and continuity tester, precision oscillator and attenuator, group selector switch, and voltage test meter. Test panels include means to terminate the amplifier inputs with a 500 ohm load, a feature used in certain test procedures.

1.3 Binary-Gain Amplifiers

1.3.1 For each amplifier there is provided a hum balance circuit, adjustable high-cut, low-cut, and alias filters, and preamplifier-gain and D.C. offset trim pots.

1.3.2 Amplifier gain is adjusted automatically in 6 db steps; the system always attempts to maintain the signal level between one-fourth and one-half of full scale. To prevent signal clipping and distortion, it is urgent to reduce gain if the signal bursts out above half scale so downward gain-ranging may take place on every alternate scan. At a 1 ms sample rate, the attack rate is 3000 db/sec. On the other hand, in the case of a varying data signal which is crossing zero many times persecond, it is apparent that some of the sample values of the signal would fall below the one-quarter scale set-point which triggers the gain increase, yet the signal peaks would be above the trigger level and the existing gain level should be continued. A means is provided to delay the gain increase until all samples fall below the trigger level. This operation is accomplished by examining all samples of a given channel for a time period which is set by a 3-position release-rate switch, having the positions, fast, medium, and slow (30, 40, 60 ms, nominal or 200, 150, 100 db/second). The release rate is an expression of the speed, in decibels per second, at which an amplifier is capable of increasing gain to follow a declining seismic signal. As soon as all samples are below the lower set point for an examination period, the gain is increased by 6 db at the next scan. Thus, with a 30 ms examination period, the gain could be increased 6 db every 30 ms or at a rate of 200 db/sec. Provision of three release rates permits the operator to select the one best suited to the data being received.

1.3.3 Each amplifier unit includes one preamplifier and two paralleled post-amplifiers. The preamplifier has a gain of 40 for systems 105 and all systems with serial number 108 and later. The output of the post-amplifiers is applied to the system multiplexer and also to the analog camera when switched to the noise monitor mode. Of the two post-amplifiers, post-amplifier 1 has selectable gains of 1 and 256; post-amplifier 2 has selectable gains of 16 and 4096. The choice of one of the two gains and one of the two post-amplifiers is a function of the gain-control unit selecting the particular amplifier. In the noise monitor mode, the amplifier gain is forced to X163,840.

1.4 Logic Control Chassis

1.4.1 The Logic Control chassis contains the master control panel, multiplexer, buffer amplifier, gain control unit, A/D and D/A converters, and control logic. Early gain controls for the amplifiers are mounted on the master control panel. The tape drive is included in this chassis unless a 10" tape drive is specified, in which case the tape is mounted in a third rack. An optional dual drive is available for continuous operations.

1.4.2 The analog outputs of the amplifier units are time-multiplexed by the amplifier multiplexer, whence each analog signal is fed to the buffer amplifier. The buffer amplifier serves both as an impedance matcher between the multiplexer and the A/D converter and as an element of the binary gain amplification scheme. Binary signals from the control unit select any one of four buffer-amplifier gains of 1, 2, 4, or 8. The selected buffer-amplifier gain, combined with one of the four gains in the post-amplifiers, result in 16 binary gain steps from 1 to 32,768.

1.4.3 The Gain Control Unit originates a 4-bit gain code to select the gain of one of the two post amplifiers and to control the gain of the buffer amplifier. In general, when the analog value being digitized falls below one-quarter scale, the gain control unit increases the gain code by 1. When the value exceeds one-half scale, the gain control unit decrements the gain code by 1. These values are acquired by decoding the digital outputs of the A/D converter.

1.4.4 The Input Control Unit controls flow of data from the A/D converter, gain control unit, file counter, time counter and other sources to the input bus. This unit sequences and formats the data words into two 8-bit bytes, generates the parity bit, and writes the data on tape via the tape write unit.

1.4.5 The A/D converter is a 14-bit-plus-sign binary converter with complement output for negative numbers. It is controlled by a single start line originating in the input control unit. A trigger pulse on this line for each seismic channel starts the entire conversion sequence. The bit circuits continuously track the analog signal; then, after a particular analog signal has settled, the start signal initiates the sequential clamping of the bit circuits. In this way the precise digital value is achieved very rapidly by successive approximation. The digital output levels are applied to the input bus and are also used to control the gain control units.

1.4.6 The D/A converter accepts the magnitude bits furnished by the A/D converter as well as the 4-bit gain code from the gain control unit. It uses both of these--as mantissa and exponent--in a floating point representation to generate an analog signal with three significant features: (1) The analog output contains the full dynamic range of the system in a form capable of representation on a recording oscillograph. (2) The gain steps that would ordinarily be visible when the system moves from one gain code to another are smoothed. (3) The value of the analog signal is normalized around a manually set playback level although rapid changes such as burst-outs are not normalized. The final result is a camera record on which both the average signal value and the reflections are clearly visible for the entire length of the file. On high-gain models, the gain change blips can be displayed at the operator's option.

1.5 Magnetic Tape Unit

1.5.1 The Magnetic Tape Unit is a field tape transport accommodating 9-track tape, 1/2-inch wide, on 8-1/2 or 10 inch reels. Direction of tape motion, startup and shutdown are controlled by the system control unit on the basis of the mode selected; tape speed depends upon the sampling rate selected.

1.5.2 A beginning-of-tape sensor determines when first recording may commence, and the end-of-tape sensor warns of the approach of the tape end. If the EOT marker is sensed while

a file is being recorded, recording will continue past the EOT mark until the file is completed but no further recording can be done on that reel. It should be noted that this capability is possible because the EOT marker is located 114 feet from the actual end of tape. The tape transport is interlocked with a number of system and transport conditions so that it can operate only when all conditions are ready.

1.5.3 Use of the seismic recording system may involve interlaced recording or playback operations; therefore, a special type of file protection system is provided. This over-write protection uses the electronic detection of data on the tape to inhibit writing. An advance-to-end-of-data control allows the system operator to automatically reposition the tape at the end of the previously recorded data. As a result, it is possible to record a file, replay it or another file, and go ahead with more recording with no chance of inadvertently over-writing data.

1.5.4 In addition to the electronic data-detector-write-inhibitor, conventional write-ring protection is provided. This feature assures the operator that previously recorded data cannot possibly be damaged. If desired, the erase head and electronic file protect can be disabled when recording in the continuous forward mode and, in this case, file protection is available only via the write-ring file protect.

1.5.5 The write logic generates IBM-compatible odd vertical parity which is recorded on tape along with the data. Parity errors are displayed by means of indicator-lights; whenever an excess of parity errors occurs, an audible and visible alarm is activated. The usual EOF characters are generated automatically after the recording has been completed; a manual EOF switch is also available.

1.5.6 A special switch is provided to write a block of all 1's. This block, of indefinite length, is used to check skew.

1.6 Playback Amplifiers

1.6.1 Seismic signals can be displayed in the noise monitor mode, in read-after-write mode in real time, or selected files can be played back to the camera.

1.6.2 When the noise-monitor mode is entered, signals are taken from the output of post-amplifier 2 and are fed to the camera. In this mode, the gain is forced to X163,840.

1.6.3 Characteristics of the read-after-write mode are: First, the gain steps are removed. Second, the average signal level of the playback record is held constant, despite the fact that the average signal level in the original signal is declining in the typical seismic fashion. Third, bursouts are preserved in their true relationship to the signal envelope level at the point where they occurred. The rate at which the average envelope level is

is used for indicators and relays, and the battery voltage is used directly for motors and heaters.

1.9 Block Diagram

1.9.1 A simplified block diagram is illustrated in Figure 1.

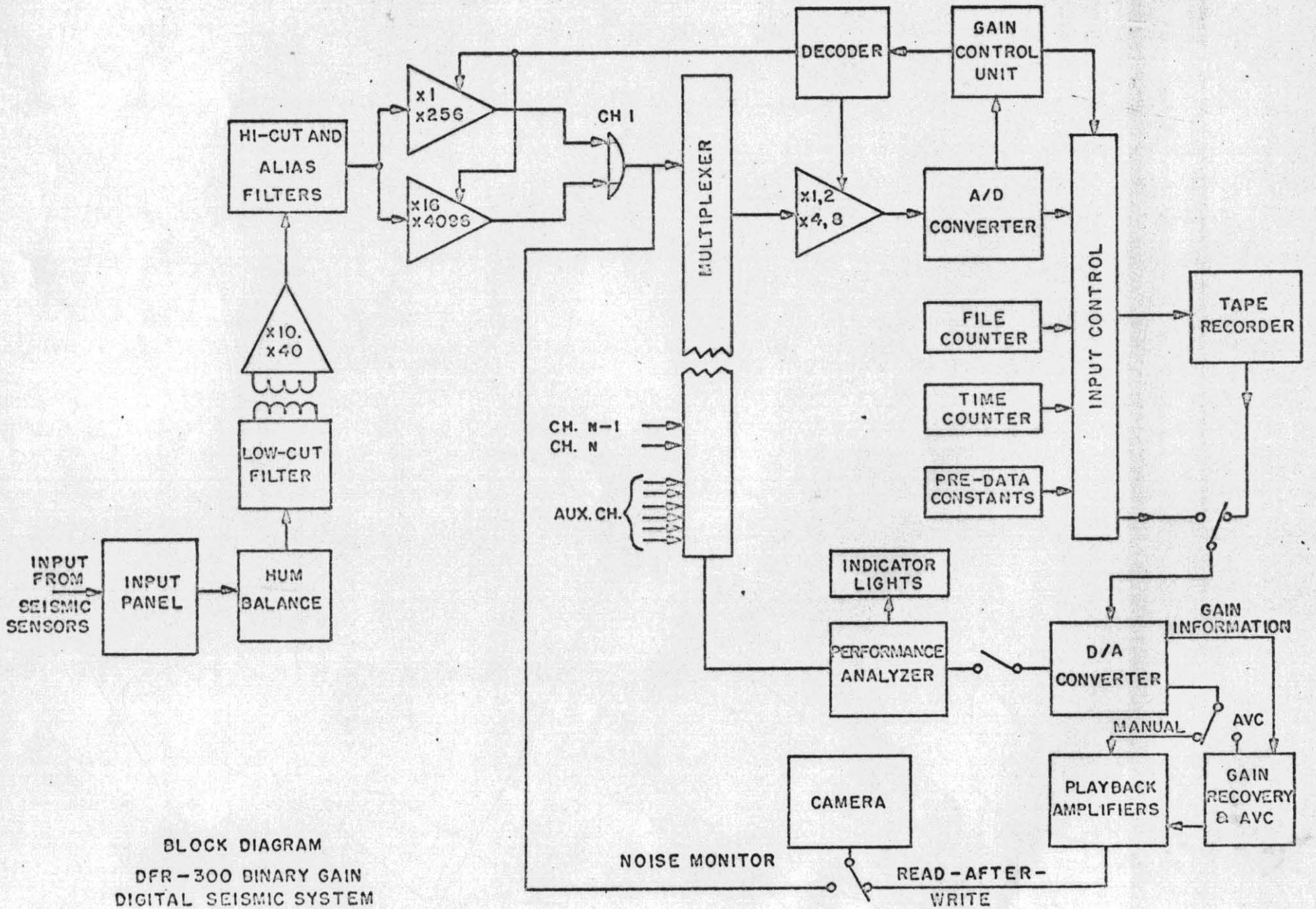


Figure 1

BLOCK DIAGRAM
DFR-300 BINARY GAIN
DIGITAL SEISMIC SYSTEM

WESTERN GEOPHYSICAL

2. Specifications

2.1 System Specifications

Number of inputs	24 data channels plus 6 auxiliary channels
Maximum input signal	250 mv zero to peak, Systems 105, 108 and later
Input impedance	500 ohms nominal
Minimum gain	32 db, Systems 105, 108 and later
Automatic gain range, binary gain amplifiers	90 db, Systems 105, 108 and later
Attack rate (@ 1 ms sample rate)	3000 db/sec
Release rate	200, 150, 100 db/sec (30, 40, 60 ms delay, nominal)
Cross talk	Greater than 66 db down from full scale
Harmonic distortion	0.1% from 10 Hz to 250 Hz
Sample rate accuracy	0.01%
System resolution (A-D)	15 bits including sign
System resolution (D-A)	10 bits including sign manually left shiftable on Systems 105 and 108 or later, up to 84 db
Data code	15 bits in 2 bytes, 1's complement
Noise	Less than 0.5 uvp RTI
Redundancy check	Odd vertical parity
Computer codes	Longitudinal redundancy character (LRC) Cyclic redundancy character (CRC)
Search capability	Forward and reverse for three-digit file identification
Playback AGC control	3 positions: fast, medium, slow
Sample rate	1, 2, or 4 ms per scan, switch-selectable
Voltage required	12 v DC

2.2 Multiplexer, A/D converter

Input	±10 v from seismic amplifier
Number of inputs	30
Noise	±0.6 mv peak referred to ±10 v peak at input to A-D
Accuracy	±1/2 least significant bit
Negative numbers	1's complement
Linearity	Better than 0.02%

2.3 D/A Converter

Code input	Binary, 1's complement
Number of bits	10 bits, including sign
Output amplitude	±10 v peak maximum
Gain stability	±0.02%
Accuracy	±0.1%
Output impedance	0.01 ohm at DC

2.4 Magnetic Tape Unit

Speeds	20, 40, 80 ips
Speed Tolerance	±2% long term
Direction	bidirectional
Tape Width	1/2" (0.498 ±0.002)
Recording	IBM compatible
Packing Density	800 bpi
Tracks	9
Track Spacing	ASI standard
Tape Sensing	Photo-reflective IBM compatible; both BOT and EOT

Read Direction	3 speeds forward, 1 speed reverse
File protection	Electronic and/or write-ring file protection
Erase head	
Reels	8½" or 10" compatible with IBM hubs and snap-off locks

2.5 Filter Amplitude Response Curves

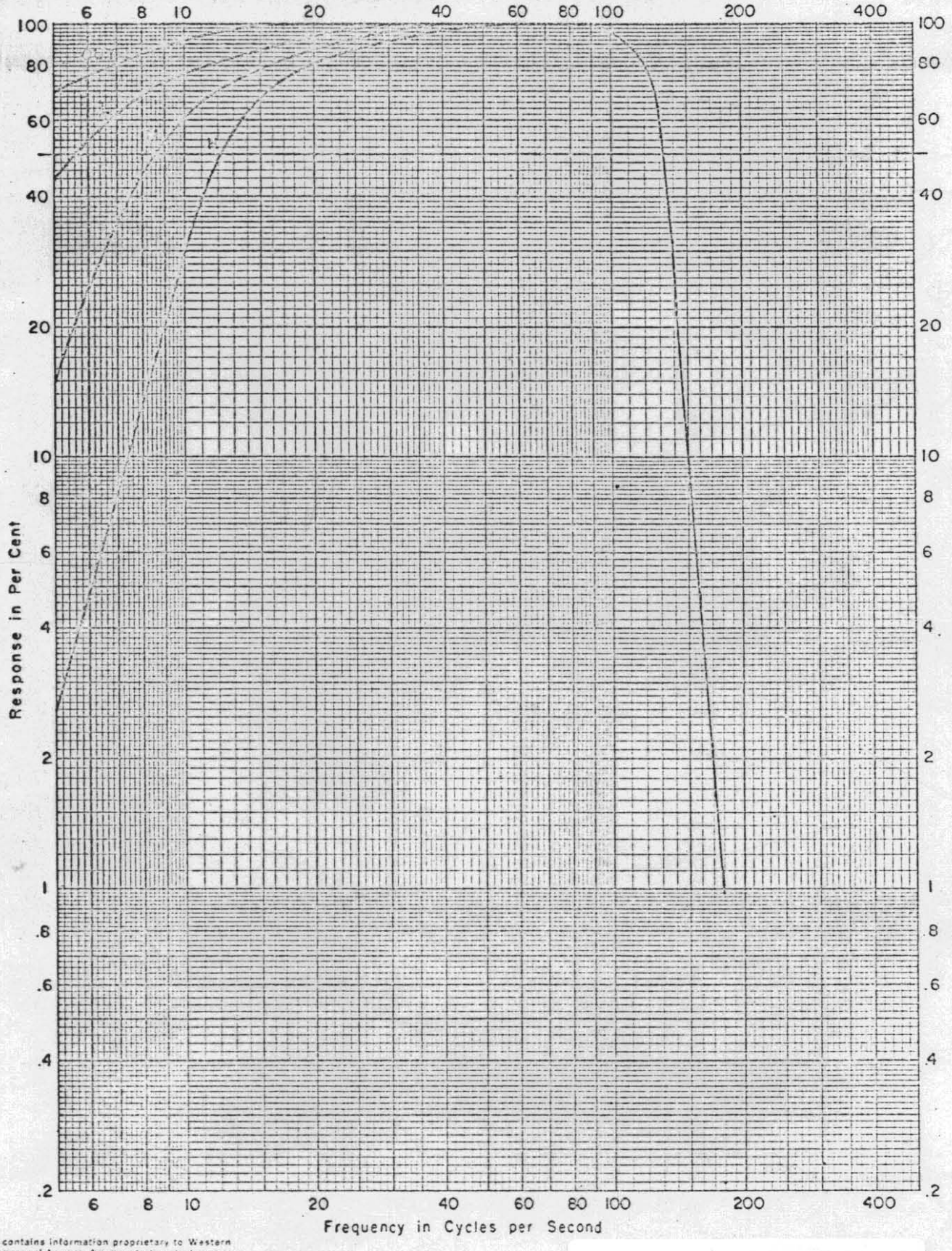
2.5.1 Refer to Figures 2 and 3

051031

AMPLITUDE RESPONSE

SDS BINARY GAIN AMPLIFIER
SERIES DFR-300
LOW CUT FILTERS

AMPLIFIER ONLY
HIGH CUT FILTERS-OUT
ALIAS FILTER -2MS



This drawing contains information proprietary to Western Geophysical Company of America. Any reproduction, disclosure or use of this drawing is expressly prohibited except as Western Geophysical Company of America may otherwise agree in writing.

5 cm

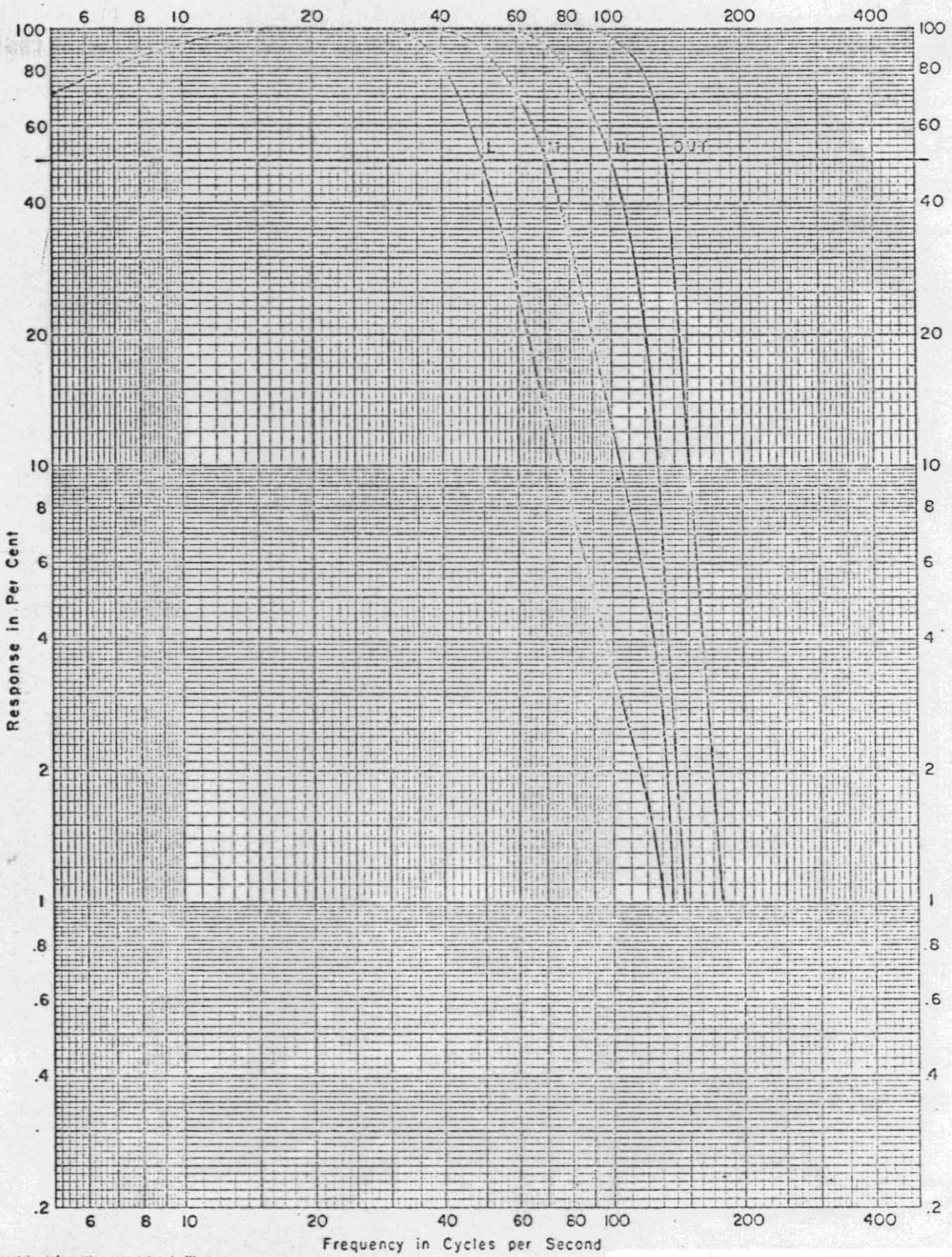
FIGURE 2.

051032

AMPLITUDE RESPONSE

SDS BINARY GAIN AMPLIFIER
SERIES DFR-300
HIGH CUT FILTERS

AMPLIFIER ONLY
LOW CUT FILTER – OUT
ALIAS FILTER – 2 MS



This drawing contains information proprietary to Western Geophysical Company of America. Any reproduction, disclosure or use of this drawing is expressly prohibited except as Western Geophysical Company of America may otherwise agree in writing.

5 cm

FIGURE 3.

APPENDIX B

051033

DATA PROCESSING PROCEDURES

Processing of field data was carried out at the Geophysical Services International Digital Processing Centre located in St. Leonards, N.S.W.

The Centre consists of two digital computers designed and built by the Texas Instrument Company especially for geophysical data reduction with the necessary I/O units.

1. TIAC MODEL 827A: This is a modified version of the TIAC 837 computer with increased storage capacity, a faster convolver unit and a more efficient supervisory program. All GSI processing programs that are in use can be run on this computer.

2. TIAC MODEL 870: The newest of the TIAC series which is capable of processing 7,9, and 21 track field tapes. This unit is used for format conversions, analog to digital transcriptions, general seismic processing, and controls the on-line camera plotter unit for section presentation.

Processing of field data included EPR to TIAC format conversion, gain recovery and record summing on the TIAC 870, general processing with GSI-400 process package on the TIAC 827A, and TIAC 870 controlled plotting on the SIE plotter Model PL 605. The 400 process package is composed of a series of optional programs processed in continual sequence for maximum operational efficiency. The programs are comprised of the following routines;

1. WMT: Write intermediate output records.

2. LEANMO or MEANMO: Automated edit, true amplitude recovery, static corrections and normal moveout corrections for Land or Marine records.

3. RNM: Residual moveout corrections, edit and static corrections.

4. ARD: Time-invariant deconvolution with maximum of 64 points per filter and without filter normalization.

5. DCN: Time-invariant deconvolution with a maximum of 510 points per filter and filter normalization.

6. TVD: Time-variant deconvolution with a maximum of 58 points per filter and optional filter normalization.

7. ARD2: Deconvolution for reverberations in the water layer.

8. DGF: Time-invariant digital or antialias filtering.

9. TVF: Time-variant digital filtering.

10. DPS: N-fold CDP stacking of records from continuous spread (all group intervals equal) and exponential scaling and trace equalization of output.

051034

11. MXG: N-fold mixing and exponential scaling and trace equalization of output.

12. SOS: Split offset stack to correct for variation in group intervals and offset distances.

For general processing of recorded field data routines 1, 2, 5, 6, 8, 9 and 10 were used in various combinations. Additional routines were used in filter evaluations, deconvolution analysis, power density spectrum analysis, autocorrelation functions, and data quality evaluations.

The computation of the Time Vs. Avge. Velocity curves used in the NMO routine were derived from velocity gathers from the field tapes. Final corrected velocities were computed for each area of shooting. These calculations were carried out by Esso personnel.

In the processing of the six-fold CDP data, single fold monitor sections were displayed before and after stacking to insure that the best possible velocity control had been used.

The final section plotting was done on film using the variable density mode. A high precision densitometer was used to keep the zero signal density level at the mid point of the linear portion of the film exposure scale. All sections were plotted at 3.75 inches per second vertical scale and 24 traces per inch horizontal scale.

In order to obtain the best possible data quality output, two to four Esso personnel were officed at the GSI Processing Centre at all times.

APPENDIX C

BASS BASIN

GENERALIZED TIME VS DEPTH CHART

800	.272
1000	.330
1200	.384
1400	.436
1600	.485
1800	.531
2000	.580
2200	.633
2400	.689
2600	.744
2800	.798
3000	.852
3200	.906
3400	.960
3600	1.011
3800	1.059
4000	1.107
4200	1.152
4400	1.196
4600	1.239
4800	1.280
5000	1.320
5200	1.358
5400	1.394
5600	1.431
5800	1.470
6000	1.510
6200	1.550
6400	1.590
6600	1.628
6800	1.664
7000	1.700
7200	1.738
7400	1.776
8000	1.880

TRANSMITTAL FORM

051036

Bass Basin part VII

From: ESSO EXPLORATION AUSTRALIA, INC.
Box 4249, G.P.O.,
Sydney, N.S.W., Australia.

To: The Director of Mines,
Department of Mines,
G.P.O. Box 124B,
HOBART, TASMANIA 7001

NATURE OF DOCUMENTS	NUMBER OF COPIES
Seismic sections of EF, Reprocessed Band ES surveys and EF survey move-out scans	one copy of each as per attached list

Final Subsidy Report

Total 55 (sections) 30 (scans)

Date Sent: _____ By X (Air)
_____ (Surface)

Date Received: _____

Please acknowledge receipt by signing ~~and returning~~ one copy.

By E A Kean
Esso Exploration Inc.,

Date 11.12.68

Line	Shot Points
EF 27	3023-2843
	3119-3029
33	729-843
52	1911-2043
	2049-2175
	2181-2295
73	2566-2698
	2704-2842
76	3122-3266
85	1077-1011
86	845-911
87	1006-916
88	724-538
89	1-85
90	181-91
91	185-285
92	400-286
93	533-407
94	1080-1266
	1272-1458
	1464-1618
95	1619-1751
	1757-1910
96	2430-2298
	2562-2436
97	3270-3408
	3414-3606
98	3609-3789
	3795-3981
	3987-4047

Reprocessing

B1-	362-332
	331-318A
	6A-1025
	1026-1056
	1057-1088

Line	Shot Points
B20	107-81
	142-108
	168-143
	201-169
B22	31-1
	50-32
ES40	7546-7570
	7571-7598
46R	7190-7222
	7223-7254
55	8590-8780A
56	8866-9000
	9010-9090
62	9420-9264
63	9133-9220A
	9260-9092
74	1920-1886
	1885-1851
79R	7299-7269
	7268-1683

Scans

Shot Point	Shot Point
EF94: 1170	EF95:1631
1176	1637
1182	1643
1197	1697
1203	1703
1209	1709
1263	1793
1269	1799
1275	1805
1473	1844
1479	1850
1485	1856
1548	1874
1554	1880
1560	1886

051038

Bass Basin part VII

TRANSMITTAL FORM

From: ESSO EXPLORATION AUSTRALIA, INC.
Box 4249, G.P.O.,
Sydney, N.S.W., Australia.

To: The Director of Mines,
Department of Mines,
G.P.O. Box 124B,
HOBART, TASMANIA 7001

NATURE OF DOCUMENTS	NUMBER OF COPIES
Seismic sections of EF, Reprocessed Band ES surveys and EF survey move-out scans	one copy of each as per attached list

Final Subsidy Report

Total 55 (sections) 30 (scans)

Date Sent: _____ By X (Air)
_____ (Surface)

Date Received: _____

Please acknowledge receipt by signing and returning one copy.

By _____
Esso Exploration Inc.,

Date 11.12.68

Line	Shot Points
EF 27	3023-2843
	3119-3029
33	729-843
52	1911-2043
	2049-2175
	2181-2295
73	2566-2698
	2704-2842
76	3122-3266
85	1077-1011
86	845-911
87	1006-916
88	724-538
89	1-85
90	181-91
91	185-285
92	400-286
93	533-407
94	1080-1266
	1272-1458
	1464-1618
95	1619-1751
	1757-1910
96	2430-2298
	2562-2436
97	3270-3408
	3414-3606
98	3609-3789
	3795-3981
	3987-4047

Reprocessing

B1-	362-332
	331-318A
	6A-1025
	1026-1056
	1057-1088

Line	Shot Points
B20	107-81
	142-108
	168-143
	201-169
B22	31-1
	50-32
ES40	7546-7570
	7571-7598
46R	7190-7222
	7223-7254
55	8590-8780A
56	8866-9000
	9010-9090
62	9420-9264
63	9133-9220A
	9260-9092
74	1920-1886
	1885-1851
79R	7299-7269
	7268-1683

Scans

Shot Point	Shot Point
EF94: 1170	EF95: 1631
1176	1637
1182	1643
1197	1697
1203	1703
1209	1709
1263	1793
1269	1799
1275	1805
1473	1844
1479	1850
1485	1856
1548	1874
1554	1880
1560	1886

951040

Bass Basin part VII

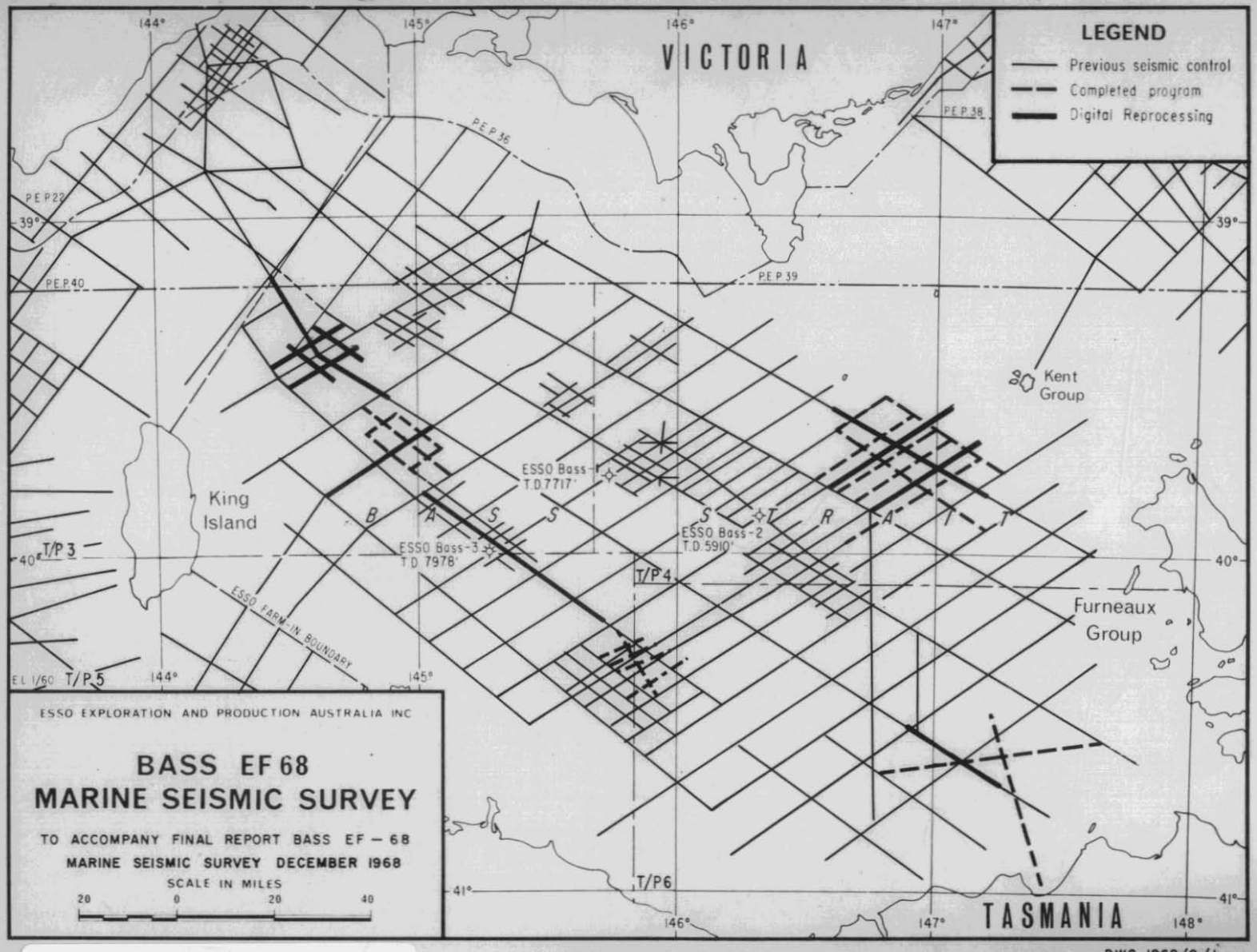


FIGURE 1

DWG. 1062/G/1

OR-007

Bass Basin part VII

051041

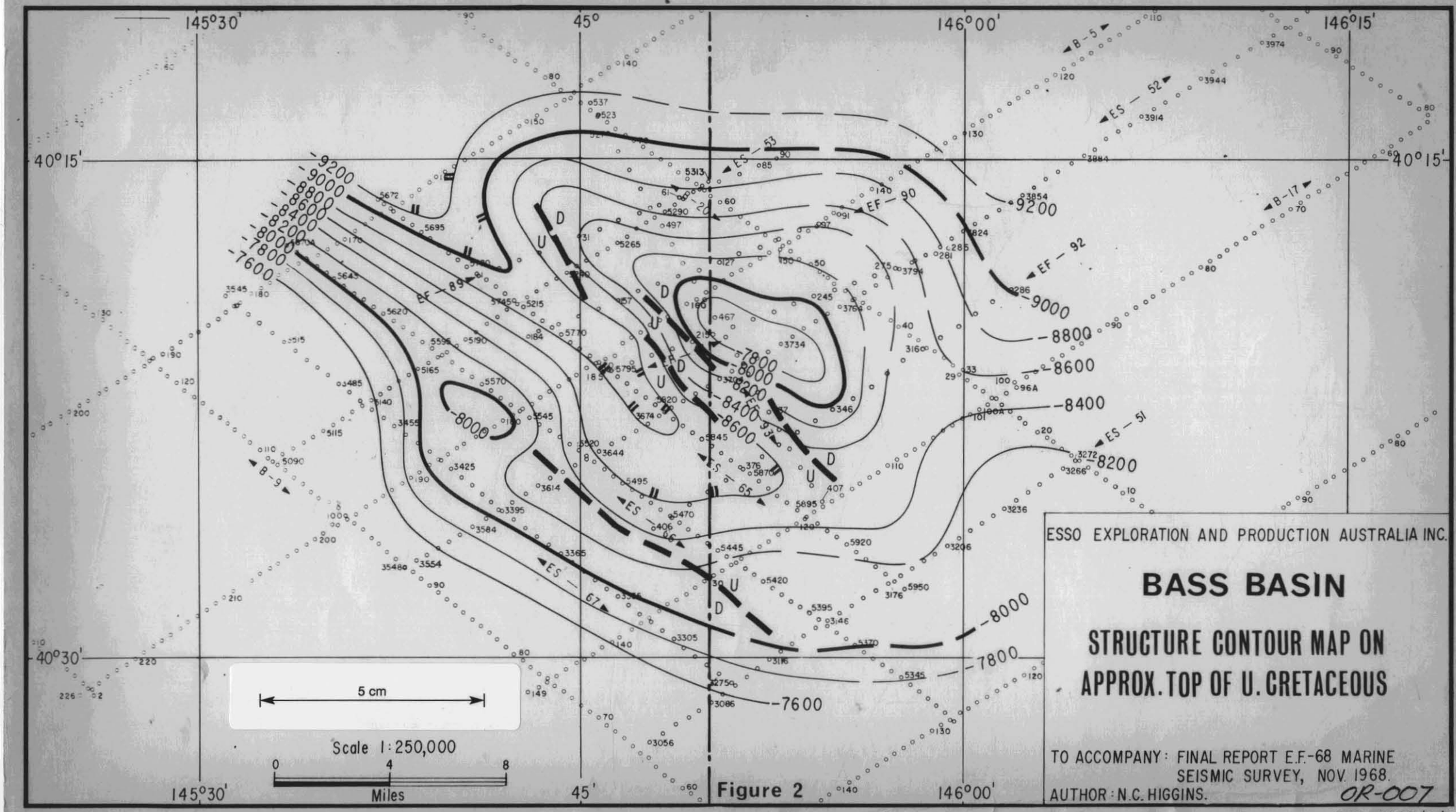


Figure 2

ESSO EXPLORATION AND PRODUCTION AUSTRALIA INC.

BASS BASIN

STRUCTURE CONTOUR MAP ON APPROX. TOP OF U. CRETACEOUS

TO ACCOMPANY: FINAL REPORT E.P.-68 MARINE SEISMIC SURVEY, NOV. 1968.

AUTHOR: N.C. HIGGINS.

OR-007

DWG. 1062/G/2

PEP 40

PEP 36

WILSONS PROMONTORY

VICTORIA
TASMANIA

P.E.P. 40 ESSO–HEMATITE

P.E.P. 36 ALLIANCE

VIC/P2 ESSO–HEMATITE

EAST MONCOEUR

WEST MONCOEUR

HOGAN GP

CURTIS GP

KENT GP

ESSO–HEMATITE OTWAY FARM–IN BOUNDARY

ESSO–HEMATITE BASS FARM–IN BOUNDARY

ZERO EDGE OF OLIGOCENE

FRIGATE

PENGUIN

KING ISLAND

FLINDERS ISLAND

T/P3 ESSO–HEMATITE

T/P4 ESSO–HEMATITE

ESSO–HEMATITE BASS FARM–IN BOUNDARY

ESSO–HEMATITE OTWAY FARM–IN BOUNDARY

PELICAN

HERON

THREE HUMMOCK ISLAND

HUNTER ISLAND

ROBBINS ISLAND

ZERO EDGE OF OLIGOCENE

TASMANIA

T/P5 ESSO–HEMATITE

T/P6 ESSO–HEMATITE

TASMANIA

LEGEND

- —2000— Structure Contour in Feet
- Seismic Shot Point
- U / D Fault 'D' downthrown Side
- Well, abandoned with Gas Show
- Well, dry and abandoned
- Petroleum Tenement Boundary
- ←EK–10→ East King Island, Seismic Survey
- Areas of Oligocene volcanic build–ups
- Basement at surface due to block faulting

MAP INDEX

ESSO EXPLORATION AND PRODUCTION AUSTRALIA INC.

THE BASS BASIN

VICTORIA – TASMANIA

STRUCTURE CONTOUR MAP ON TOP OF OLIGOCENE

5 cm

051042

CONTOUR INTERVAL 250 FEET

DATUM – SEA LEVEL

Scale 1:250,000

4 0 4 8 12

MILES

AUTHOR: N.C. HIGGINS AND P.J. BIRMINGHAM DRAFTED BY A.F. STRAHAN

TO ACCOMPANY FINAL REPORT, EF 68 MARINE SEISMIC SURVEY DATE: NOV. 1968

PLATE I

DWG. 1062/6/3

Bass Basin part VII

OE-007

PEP 40

PEP 36

VICTORIA
TASMANIA

P.E.P. 40 ESSO – HEMATITE

P.E.P. 36 ALLIANCE

VIC/P2 ESSO – HEMATITE

T/P3 ESSO – HEMATITE

T/P4 ESSO – HEMATITE

T/P5 ESSO – HEMATITE

T/P6 ESSO – HEMATITE

ESSO – HEMATITE OTWAY T&PR – IN BOUNDARY

ESSO – HEMATITE BASS T&PR – IN BOUNDARY

ESSO – HEMATITE BASS T&PR – IN BOUNDARY

ESSO – HEMATITE OTWAY T&PR – IN BOUNDARY

WILSONS PROMONTORY

EAST MONCOEUR

WEST MONCOEUR

HOGAN GP

CURTIS GP

KENT GP

FLINDERS ISLAND

KING ISLAND

THREE HUMMOCK ISLAND

HUNTER ISLAND

ROBBINS ISLAND

TASMANIA

FRIGATE

PELICAN

HERON

ZERO EDGE OF EOCENE

ZERO EDGE OF EOCENE

PENGUIN

Area of no data beneath Oligocene volcanic build-up

LEGEND

- —2000— Structure Contour in Feet
- Seismic Shot Point
- Fault 'D' downthrown Side
- Well, abandoned with Gas Show
- Well, dry and abandoned
- Petroleum Tenement Boundary
- ⇤ EK – 10 ⇥ East King Island, Seismic Survey
- Areas of Eocene Volcanic build-ups
- Stock
- Stock with flat surface (may be tilt with deeper reflections masked)
- Basement at surface due to block faulting

MAP INDEX

ESSO EXPLORATION AND PRODUCTION AUSTRALIA INC.

THE BASS BASIN

VICTORIA – TASMANIA

STRUCTURE CONTOUR MAP ON TOP OF EOCENE

5 cm

051043

CONTOUR INTERVAL : 250 FEET DATUM : SEA LEVEL

Scale 1:250,000

4 0 4 8 12

MILES

AUTHOR : N.C. HIGGINS AND P.J. BIRMINGHAM DRAFTED BY : M.R.CHATENAY

TO ACCOMPANY FINAL REPORT, EP 88 MARINE SEISMIC SURVEY DATE: NOV. 1968

PLATE II

DWG. 1082/6/4

Bass Basin part VII

dr-007

PEP 40

PEP 36

WILSONS PROMONTORY

VICTORIA
TASMANIA

P.E.P. 40 ESSO – HEMATITE

P.E.P. 36 ALLIANCE

VIC/P2 ESSO – HEMATITE

EAST MONCOEUR
WEST MONCOEUR

HOGAN GP

CURTIS GP

KENT GP

ESSO – HEMATITE OTWAY FARM – IN BOUNDARY
ESSO – HEMATITE BASS FARM – IN BOUNDARY

BASEMENT REFLECTION MISSING IN CENTER OF BASIN

FRIGATE

PENGUIN

HERON

PELICAN

KING ISLAND

FLINDERS ISLAND

T/P3 ESSO – HEMATITE

T/P4 ESSO – HEMATITE

T/P5 ESSO – HEMATITE

T/P6 ESSO – HEMATITE

ESSO – HEMATITE BASS FARM – IN BOUNDARY
OTWAY FARM – IN BOUNDARY

Area of no data beneath Oligocene volcanic build up

THREE HUMMOCK ISLAND

HUNTER ISLAND

ROBBINS ISLAND

TASMANIA

TASMANIA

LEGEND

- —2000— Structure Contour in Feet
- Seismic Shot Point
- U / D Fault 'D' downthrown Side
- Well, abandoned with Gas Show
- Well, dry and abandoned
- Petroleum Tenement Boundary
- ⟵ EX – 10 ⟶ East King Island, Seismic Survey
- Basement at surface due to block faulting

MAP INDEX

ESSO EXPLORATION AND PRODUCTION AUSTRALIA INC.

THE BASS BASIN

VICTORIA – TASMANIA

STRUCTURE CONTOUR MAP ON TOP OF BASEMENT

5 cm

051044

CONTOUR INTERVAL - 500 FEET

DATUM: SEA LEVEL

Scale 1:250,000

0 4 8 12
MILES

AUTHOR - N.C. HIGGINS AND P.J. BIRMINGHAM

DRAFTED BY K.H. REISS.

TO ACCOMPANY: FINAL REPORT, EP 68 MARINE SEISMIC SURVEY

DATE: NOV. 1968

PLATE III

Bass Basin part VII

DWG 1062/6/5

CO. 007