



OTWAY/KING PART-IX*

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PROCESSING REPORT,
MARINE SEISMIC SURVEY,
OTWAY BASIN,

H04

For

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By

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SECTION I

INTRODUCTION

A marine seismic reflection survey was conducted by the M.V. "Eugene McDermott II" in the Otway Basin (from Cape Nelson to Cape Otway) for Hematite Petroleum Proprietary Limited between November and December, 1974.

Approximately 1272 Kilometres, (790 miles) of "72-fold, and 97 Kms, (60 miles) of 48 fold, reflection coverage were shot using a 48 trace, 3200 metre, acceleration cancelling streamer under continuous tow in conjunction with a Pneumatic Acoustic Energy Source, a 19,655 litre tuned airgun array. Field and survey operations are fully discussed under separate covers.

Digital data processing was performed in the Sydney Office of Geophysical Service International. All data were vertically stacked and processed as 24-fold data. Continuous Velocity Analysis was effected by the 700 Package Event Detection Module.



SECTION II

DIGITAL PROCESSING

The following processing sequence was applied to the data. Data were processed to record times of 5 to 8 seconds, depending on the water depth, at a sample period of 4 milliseconds.

A. SEQUENCE

1. Vertical Stack :

- a. True Amplitude Recovery.
- b. Vertical Stack (as required).

2. Pre-Processing:

- a. Trace Edit.
- b. Pre-deconvolution Ramp Scaling.
- c. Static Corrections.
- d. Deconvolution.
- e. Common Depth Point Gather.
- f. Annotation of Water Depth and Offset Information.
- g. Preliminary Stack.



3. Velocity Processing:

Full 700 Package Continuous Velocity Analysis.

- a. Moveout scan, dip search and reflection identification.
- b. Plot of picked events as a function of velocity, amplitude and dip.
- c. Primary Segment Display.

4. Post-Processing:

- a. Normal Moveout Correction.
- b. Single-fold Display.
- c. Common Depth Point Stack.
- d. Time Variant Deconvolution (TVD).
- e. Time Variant Filtering (TVF).
- f. Cross Record Mix when required.
- g. Display



B. PROGRAM AND PARAMETER DETAILS

1. Vertical Stack

a. True Amplitude Recovery (TAR)

TAR was applied to all field records. This process removed the gain imposed by the DFS III Binary Gain Control System and corrected for inelastic attenuation and spherical divergence losses.

b. 3 on 1 Vertical Stack (Sequences C & D)

The "72-fold" shooting was reduced to 24-fold 48 trace by stacking the 48 traces of three contiguous shots. This summing produces a depth point smear, but maintains correct offsets. On the tie in between "72" and 48 fold in 84B a 2:1 vertical stack of contiguous shots was merged into the 3:1 vertical stack. The main advantage of Vertical Stack is the cancellation of random noise and the reinforcing of primary data.

c. Even/Odd Vertical Stack (Sequence A & B)

Even/Odd Vertical Stack was performed reducing the 48 trace cable to 24 trace data. The Even 24 groups were stacked with the Odd 24 groups of the same shot. This produced three sets of



24-fold Common Depth Point records. Each set was processed separately and combined after Common Depth Point Stack. Using the field Q.C. reports as a guide, as well as on a random basis, the Vertical Stack records were displayed for further editing.

d. 2 on 1 Vertical Stack (Sequence E)

On line 11 and the 48 fold part of 84B, a vertical stack was performed to stack the even traces of shot 1 with the odds of shot 2 etc..., to eliminate depth point smear.

2. Pre-Processing

a. Trace Edit

Trace editing was performed based on the Vertical Stack displays. This consisted primarily of trace zeroing.

b. Pre-deconvolution Ramp Scaling

Pre-deconvolution ramp scaling was designed to suppress direct arrival energy. This was to prevent the high amplitude direct arrivals from being "blown-up" when the deconvolution operator was applied.



c. Static Corrections

Static Corrections were applied to correct for a sea level datum. A positive static correction was applied to compensate for the depth of the airgun array and streamer below sea level. A water velocity of 4900 ft./sec. was assumed when making these corrections. At the same time, a correction of 12 milliseconds was removed for the airgun delay.

d. Deconvolution

In shallow water areas with a flat water bottom the approximate deconvolution was accomplished by the application of a whitening filter designed from auto-correlation functions, which were derived from the trace to be deconvolved. Two filters were designed per trace and applied with a 50% overlap, such that the first filter tapered off while the second filter tapered on. The operators were designed as double section operators; i.e., to dereverberate the first and second water bottom reverberations.

In the area where the sea bottom was shelving a 2nd Zero crossing deconvolution was applied. This is non-whitening and has a gap equal to the second zero crossing on the auto-correlation function.

Dewater was applied in Deep Water, approximately 5000', with a flat water bottom, Deep Water Trapped Energy Removal (De-Water) is non-whitening deconvolution which is designed to significantly attenuate



simple coherent multiples generated from a deep water bottom and to attenuate peg-leg multiples generated from a primary reflecting horizon and the deep water bottom.

Firstly, normal moveout is applied to the CDP records using a constant velocity that will flatten all water bottom multiples. These corrections are removed later, after the De-Water process. De-Water utilizes an improved inverse filtering technique. The filter is designed and applied in a time variant manner to allow for changes in the frequency spectrum of the seismic data as a function of record time. The frequency spectrum of the output from De-Water approximates the envelope of the input frequency spectrum.

e. Common Depth Point (CDP) Gather

All data were output from the Pre-Processing Module in CDP format. For the data now reduced to 24-fold, each 24 trace output record represented one CDP point.

f. Annotation

The offset and the shot plus receiver water depth for each trace was annotated in channel 25 of the CDP gather record.



g. Preliminary Stack

Velocities obtained from previous year's processing were applied to every 2nd or 3rd depth point after CDP gather and the data stacked to produce a 24 fold, 24 trace section. This post-processing sequence omitted deconvolution.

The output of this module was a 5" CRT frame which was enlarged on paper.



3. Velocity Analysis:

1. Program 700-2 provides a continuous velocity analysis technique which was used to determine the complete velocity field along a line.

Inputs to this program are pre-processed CDP gather records, every depth point was submitted (33.3 or 22.2 metre depth point interval) and a 2:1 mix was performed to decimate the depth points. On these CDP records the following processed were performed:-

0 Moveout and Dip Scan Building -

A moveout scan is generated for each depth point and is formed by the application of a constant shift to each trace in proportion to the square of the offset of the trace and then stacking by mixing together all the traces in the gather to form a scan trace. The moveout applied is then incremented by a constant amount and the process repeated until the range of moveout applied exceeds the expected seismic range.

Dip scans are built by stacking together series of moveout scans from consecutive depth points along linear planes of dip which are automatically incremented within



a specified dip aperture designed to cover the expected range of dips on the seismic section. Dip apertures for each processing time gate were determined from the preliminary stack sections. The number of consecutive moveout scans stacked to form a dip scan is termed the SMASH rate and may also vary with the time gates.

- o Interpretation of Moveout/Dip Scans to detect valid events with time, amplitude and moveout, and dip information -

The automatic interpretation is based on the fact that any coherent event on the gather record will stack at the optimum moveout value to a maximum (or minimum for negative values) in the two-dimensional time moveout plane of the scan. When stacking again takes place along the dip plane, which most approximates the true geological time-dip, maximum dip scan response will be achieved. The dip scan domain is a three-dimensional one in which every coherent event from the input gather records will be represented by a maximum or minimum at that time, moveout and dip which correctly describes the original seismic event.



The resulting "TAMD picks" represent the mean time, amplitude, moveout and dip of the seismic event over a space gate of width SMASH depth points. The move-up rate is another important consideration. It refers to the number of depth points between the centre of each successive dip scan set and for these lines was made equal to the SMASH rate to give a continuous suite of dip scans sets.

- o Output to magnetic tape are the event files for each Space/Time gate -

After the event detection is performed for all space points in each time gate the Event files are written on magnetic tape.

- o Extensions of the Event files in each time gate to produce Work files -

Using search windows in time, amplitude, moveout and dip, the picked seismic events from neighbouring dip scan files can be correlated and those evolving from the same seismic horizon identified and connected. This process is called Extension and the set of connected seismic horizon events are termed Segments which are output as Work (Segment) files.



o Summary files and Consolidation files -

After all time gates have been processed, the program outputs Summary and Consolidation files in the following manner.

- Hook-up of segments between time gates to allow continuous segments across time gates.
- Output Summary Files.
- Consolidation of Summary files into continuous segments with time, amplitude and moveout at every depth point.
- Output of Consolidated Segment files on magnetic tape to be submitted for display on analysis routines.

2. Program 701 - Velocity Analysis module - provides statistical displays (scattergrams) of velocity, amplitude and dip as a function of time over the entire space and also over specified space gates. The RMS velocities are computed from the segment times and moveouts averaged over each space gate and plotted as a coded symbol for each segment. The symbols are coded according to segment length within each space gate or according to the relative length in the entire Consolidated file.



The highest amplitude segment within each 100 msec. gate is also shown by circling the rank or grading symbol. Dip and amplitude information is plotted on the right-hand side of the velocity versus time plot.

A scattergram with a listing was generated for the entire space and for each individual space gate.

3. Program 602 - Segment Sort and Display - displays the Consolidated file in a fashion suitable for section overlay. Various sorting and annotation techniques are available to aid in the interpretation of the file.

Initially, the total file was displayed as a quality control measure. Only segments greater than 24 depth points were plotted with segment numbers annotated on segments longer than 24 depth points.

The final displays (segments \geq 12 d.p.).

- a) Primary Peaks with RMS velocities averaged and annotated every 24 depth points.
- b) Primary Troughs with RMS velocities averaged and annotated every 24 depth points.



Input to Program 602 was the Consolidated file and output was on 5" CRT frame. These were enlarged to a horizontal scale of the section to be overlain (see "Display").

4. Post-Processing

The CDP gather records were input to the Post-Processing Module and the following processes applied:-

a. Normal Moveout Correction

The Normal Moveout Corrections were performed utilizing the velocity functions interpreted from the scattergrams. A velocity function was input at the location of each velocity module. A linear interpolation was performed between these functions and a velocity function calculated for and applied to each of the intermediate depth points. All velocity functions are referenced to the water top and are annotated on the section header.

b. Single-Fold Display

A single-fold section with the final stacking velocities applied was generated from the normal moveout program. This section was filtered and displayed on paper.



c. Common Depth Point Stack

Common Depth Point Stack was performed with a scaling response equal to the square root of the number of live traces contributing after first break suppression, divided by the fold. The first break suppression ramps were derived from single-fold records, to remove unwanted water-borne energy, refractions and low frequencies due to stretching in the moveout process.

These records were output on magnetic tapes which were purchased by Hematite.

d. Time Variant Deconvolution (TVD)

Time Variant Deconvolution is a multiple operator, whitening, deconvolution designed from and applied to each trace in a series of overlapping gates. Two operators (70 points) were used on all lines. The TVD operators were designed from two 50% overlapping gates extending from 200 msec. below the water bottom to 100 msec. less than total record time.

e. Time Variant Filtering (TVF)

A time variant, zero phase, digital filter was applied as shown on the side panel of each section.



f. Cross Record Mix

This process performed a weighted trace mix on the stacked data. The weighting used were 15%, 70%, 15%.

The first output trace of a record section would have 15% contribution from trace #1, 70% from input trace #2 and 15% from trace #3.

The second output trace of a record would have 15% from input trace #2, 70% from trace #3 and 15% from trace #4. This process continued for the entire line.

g. Display

All plotter displays were in a wiggle trace/variable area format at a horizontal scale of .53 mile/inch and a vertical scale of 3.75 inches/second.

For data in sequences C, D, E, F, this resulted in trace spacing of 10 traces/cm. For the sequences A & B data, this resulted in trace spacing of 15 traces/cm.

Side panels on time sections give ready access to pertinent field and processing information.



C. TIME MIGRATION AND DEPTH CONVERSION

1. Mixing :

Before migration, all data were reduced to a 66.6 metre depth point interval. This involved a vertical stack of three adjacent traces on sequences A & B and E data and a stack of 2 traces on sequence E lines. Also on line 57, a spacing of 22.2m was migrated and a prestack migration was performed using a 3:1 vertical stack on the CDP's, and migrating these as 6 fold gathers. These are fully covered under separate cover.

2. Migration stack :

Migration stack is a two-dimensional process that presents the image of reflections and diffractions at their true subsurface position, assuming that they are in the plane of the section.

The method can be considered as a two-dimensional convolution of the input time section with a wavefront chart. Hence, the "impulse response" of the multichannel filter process is a wavefront chart. For example, if a single live trace is input to the system, the output shows the peaks and troughs of that trace duplicated at many points in space on either side of the input but distributed along the contours of a wavefront chart (see Plate 2).



The principal results one should expect from this process are :

1. Lateral displacement of dipping events.
2. Diffraction patterns "collapsing" into points.
3. "Sorting out" of the complex event patterns due to buried foci.
4. "Collapsing" event overlap at faults due to diffractions at bed terminations to produce more distinct fault definition.



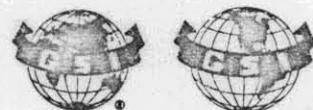
D. REFRACTION

Marine seismic refraction on lines H04-84B, 97, 99 was included in this survey. Telseis Sonobuoys were used to record and transmit the signals to an Aquatronics Sonobuoy receiver onboard ship. The data were recorded using waterbreak channel 5 onto tape channel 27.

The refraction line was gathered from the field tapes such that recordings from successive shots could be displayed adjacent to each other on the final plot.

The refraction profile was filtered with a 8-32 Hz bandpass filter and then corrected to give a delay time profile of 15,000'/sec. also 18,000'/sec. on line 84B.

Following this latter stage, the refraction profiles had adjacent traces summed. H04-84B was summed 2 on 1, while lines H04-97 and 99 had a 3 on 1 summation.



E. TELSEIS PROCESSING

As well as the standard reflection coverage recorded for the H04 Survey, two lines were experimentally recorded by onshore located receiver groups in an effort to obtain 'close inshore' reflections. This was intended to give reflection coverage beyond that available by conventional recording as the shooting vessel steamed towards the shoreline.

Consequently, lines H04-84A (SP.50 - 235) and H04-86 (SP.290 - 397) were recorded in this manner, with signals from the onshore receivers being transmitted to the Telseis unit onboard the shooting vessel and then being transferred to magnetic tape. Energy source was the standard airgun array used throughout the prospect. Breakdown of the recording procedures can be documented as follows -

H04-84A	Telseis CH.4 on DFS CH.27	Both Systems
	Telseis CH.34 on DFS CH.29	Odds Only
H04-86	Telseis CH.34 on DFS CH.27	Both Systems
	Telseis CH.4 on DFS CH.29	Odds Only

In both cases the near receiving group was designated receiver B, while the far offset group was called receiver A.



The processing flow proceeded thus -

1. Gather of the appropriate channel from field tape.
2. Application of static corrections for source depth and receiver elevations. Statics were computed as follows -
 - a) Airgun depth for both lines 25', converted to time using a velocity of 5000'/sec.
 - b) H04-84A Receiver A - 170' elevation
Receiver B - 160' elevation
Converted to time using a velocity of 6000'/sec.
 - c) H04-86 Receiver A - 30' elevation
Receiver B - 20' elevation
Converted to time using a velocity of 6000'/sec.
3. Normal Moveout Corrections.
Both lines were moveout corrected using velocities derived from the nearest stacking function used on the conventional portion of the line, converted to the water bottom.

These were -



H04-84A	5000 ft./sec.	0 ms.
	7850	475
	9000	950
	9900	1500
	10800	2000
	12600	3200
	15300	5000

H04-86	5000 ft./sec.	0 ms.
	7400	475
	7950	850
	8800	1400
	10500	1925
	12000	2425
	15600	5000

Receiver offsets were supplied by Hematite.

This stage and all subsequent stages were performed on the following portions only of the two lines -

H04-84A	SP. 186-235
H04-86	SP. 330-397



4. The static, moveout corrected portions for both lines and both receivers were then summed using adjacent traces in the following proportions - 3/1, 6/1 and 12/1.

5. Both receivers from line H04-84A were again moved out with a velocity derived from a depth profile obtained from Flaxman's No. 1 well. Down to 2.0 secs. this was slower than the previously used function, being -

5000 ft./sec.	0 ms.
5600	100
7050	500
7450	750
8250	1100
9050	1475
9350	1550
10000	1700
10600	1925
15000	5000

Again, adjacent traces were summed 3/1, 6/1 and 12/1.



6. Deconvolution was carried out on H04-86, (Receiver B, 3/1 mix records) and two filter analyses presented on deconvolved and non-deconvolved data. The effects of deconvolution were judged to be of little benefit to this data, while filtering did appear to bring out some reflection data on the near offset traces.

7. Stack and Filtering.

Using a stack diagram supplied by Hematite, the 3/1 mixed records, (the revised NMO version of H04-84A was used), were stacked as 2 fold data where appropriate, with portions on both ends of each line de-generating into single fold coverage. This data was then filtered with the following TVF -

15-40 Hz.	500 ms.
15-35	2500
10-25	3600
8-20	4300

8. Cross Record Mix.

In an effort to minimise effects of refraction energy, cross record mix was performed on the final filtered records. Contributing weights were 25%; 50% and 25%.



F. EXPERIMENTAL PROCESSING

In order to establish a processing flow for the H04 survey, preparatory experimental work was carried out on line H03-31.

Various types of analyses were presented and can be briefly tabulated as below:

- 1) Vertical Stack Comparison.
- 2) Deconvolution before Stack Comparison including Dewater.
- 3) Square Root versus Unity Stack Scaling Response.
- 4) Effect of Near Offset Muting in Stack.
- 5) Relative contribution of designated Offset Groups to Stack.
- 6) Time Variant Filter Comparisons.
- 7) Various Passband Comparisons.
- 8) 700 Package Velocity Analysis Comparisons, including Alternate and Every Depth Point Processing, increased Processing Fold Option, Filter Test, and Smash and Move-up significance.
- 9) Autocorrelations presented on various types of data.

Evaluation of these comparisons led to the processing sequence as outlined in Section II, A and B.



Respectfully submitted,
GEOPHYSICAL SERVICE INTERNATIONAL

K. Paine for

Steve Jeffrey
Party Chief

Ken Graybill

Ken Graybill
Data Processing Manager



APPENDIX A

Line and Shotpoint Index:-

<u>LINE</u>	<u>SHOTPOINTS</u>	<u>MILES</u>	<u>PROCESSING SEQUENCES</u>
H04-47	1-246	10.19	A
H04-96	1-266B	11.02	A
H04-97	1-385C	15.95	A
H04-98	1-266C	11.02	A
H04-99	1-397C	16.45	A
H04-99	1- 89	3.69	D
H04-100	90-259	7.04	A
H04-101	1-393B	16.33	D
H04-102	1-500C	20.71	D
H04-58	169-265C	3.89	B
H04-57	1-302	12.01	B
H04-57	303-638	13.92	A
H04-40	1-162B	6.71	A
H04-41	1-126B	5.22	A
H04-95	1-159	6.59	A
H04-62	1-129C	5.34	A
H04-29	1-138B	5.72	A
H04-28	1-123	5.1	A
H04-43	1-404C	16.74	A
H04-103	1- 73	30.25	D
H04-94	1-948	39.28	D
H04-38	1-251	10.40	D
H04-37	1-148	6.13	D
H04-37A	1-303	12.55	A
H04-36	1- 78	3.23	D
H04-35	1-225	9.32	D



<u>LINE</u>	<u>SHOTPOINTS</u>	<u>MILES</u>	<u>PROCESSING SEQUENCES</u>
H04-34	1-157	6.50	D
H04-76	1-136	5.64	D
H04-87	1-233	9.65	A
H04-86	1-397	16.45	A
H04-84B	1-409	16.94	A
H04-84B	410-505	3.95	B
H04-84B	506-627	5.04	F
H04-84B	627-1673	43.40	E
H04-52	1-253	10.48	A
H04-83	1-134	5.55	A
H04-84A	1-235C	9.74	A
H04-84A	1-169	7.00	A
H04-73	1-391	16.15	A
H04-14	1-176C	7.29	A
H04-14	259-545B	24.02	A
H04-13	1-215C	8.91	A
H04-12	1-255C	10.57	A
H04-10	1-666C	27.59	A
H04-65	1-712	29.50	A
H04-65	1-769	30.96	A
H04-82	770-912	5.92	D
H04-8	1-218	9.03	A
H04-81	1-666	11.64	A
H04-6	1-281	25.59	A
H04-80	1-556	23.04	A
H04-80	1-408	16.92	E
H04-50	546-838C	23.16	A
H04-90	1-207	8.58	A
H04-92	1-320	13.26	A



<u>LINE</u>	<u>SHOTPOINTS</u>	<u>MILES</u>	<u>PROCESSING SEQUENCES</u>
H04-88	1-772	31.99	A
H04-91	1-558	23.12	D
H04-93	1-591	24.49	D
H04-89	1-984	40.77	D



APPENDIX B

PROCESSING SEQUENCE CODES

- A. 3200m, 22.2m pop, 2:1 VST ODD/EVEN, Gather, TVD, full 700 Pk utilizing a 2:1 increased processing fold post processing 3x24 fold x 24 trace data.
- B. As A but substituting Dewater for TVD.
- C. 3200m, 22.2m pop, 3:1 VST. To give 2 sets of 24 fold CDP Data, equivalent to 24 fold 48 trace Data. Full 700 Pkg utilizing 2:1 IPF.
- D. As C but substituting Dewater for TVD.
- E. 3200m, 33.3m pop, 2:1 VST to give 24 fold 48 trace Data. Full 700 Pkg utilizing a 2:1 IPF, with Dewater substituted for TVD.
- F. 3200m, 22.2m pop 3:1 VST adjacent pops merging into
- 3200m, 33.3 pop 2:1 VST adjacent pops to produce continuous coverage on Line H04-84B, with full 700 Pkg utilizing a 2:1 IPF.

APPENDIX C.PARAMETERS FOR 700 PACKAGE.

Basic parameters are presented in a tape log format. Line, shotpoint range and dip values used on individual processing gates are documented in this manner. While smash and move-up rate are not expressed on these forms, this information can be established from the following -

4 gate processing (deeper water areas) :

	<u>Smash</u>	<u>Move-up</u>
Gate 1	0	0
2	4	3
3	6	4
4	8	8

5 gate processing (shallower water areas) :

	<u>Smash</u>	<u>Move-up</u>
Gate 1	0	0
2	4	4
3	4	3
4	6	4
5	8	8

DIP				LINE	SP's	DP's	XREF	VCO	TCO	ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORD & GATHERS	REMARKS
TIME	DIP														
0	0.1	0	0	H04 - 82	1 - 96					ALT			1		
0.1	0.5	-2	2												
0.5	1.2	-4	4												
1.2	2.6	-6	4												
2.6	5.0	-7	5												
0	0.1	0	0	H04 - 82	97 - 192					ALT			101		
0.1	0.5	-2	2												
0.5	1.2	-4	4												
1.2	2.6	-4	6												
2.6	5.0	-8	7												
0	0.1	0	0	H04 - 82	193 - 288					ALT			201		
0.1	0.5	-2	2												
0.5	1.2	-4	4												
1.2	2.6	-10	12												
2.6	5.0	-7	13												
0	0.1	0	0	H04 - 82	289 - 384					ALT			301		
0.1	0.5	-2	2												
0.5	1.2	-3	5												
1.2	2.6	-8	3												
2.6	5.0	-18	12												
0	0.1	0	0	H04 - 82	385 - 480								401		
0.1	0.5	-2	2												
0.5	1.2	-3	3												
1.2	2.6	-10	5												
2.6	5.0	-8	13												

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DIP				LINE	SP's	DP's	XREF	VCO	TCO	ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORD & GATHERS	REMARKS
TIME	DIP														
0	0.1	0	0	H04 - 82	481 - 576					ALT			501		
0.1	0.5	-2	2												
0.5	1.2	-3	4												
1.2	2.6	-4	13												
2.6	5.0	-8	8												
0	0.1	0	0	H04 - 82	577 - 672					ALT			601		
0.1	0.5	-2	2												
0.5	1.2	-3	8												
1.2	2.6	-15	8												
2.6	5.0	-8	8												
0	0.1	0	0	H04 - 82	673 - 768					ALT			701		
0.1	1.0	-2	18												
1.0	1.8	-3	10												
1.8	2.6	-11	18												
2.6	5.0	-9	16												
0	0.9	0	0	H04 - 82	769 - 880					ALT			1001		
0.9	1.7	-3	23												
1.7	2.6	-10	6												
2.6	3.9	-5	13												
3.9	6.0	-11	22												

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DIP				LINE	SP's	DP's	XREF	ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORDS & GATHERS	REMARKS
Time	Dip												
0	.1	0	0	H04-10	1-98	294	11130	EVY 2:1 Mix	3001	10001	1	10041	
.1	.5	-2	2										
.5	1.2	-3	3										
1.2	2.6	-3	7										
2.6	5.0	-7	7										
0	.1	0	0	H04-10	97-194	294	11130	EVY 2:1 Mix	3021	10101	101	10141	
.1	.5	-2	2										
.5	1.2	-5	2										
1.2	2.6	-5	5										
2.6	5.0	-6	6										
0	.1	0	0	H04-10	193-210	294	11130	EVY 2:1 Mix	3041	10201	201	10241	
.1	.5	-2	2										
.5	1.2	-5	2										
1.2	2.6	-8	8										
2.6	5.0	-10	13										
0	.1	0	0	H04-10	289-386	294	11130	EVY 2:1 Mix	3061	10301	301	10341	
.1	.5	-2	2										
.5	1.2	-4	2										
1.2	2.6	-5	5										
2.6	5.0	-6	6										
0	.1	0	0	H04-10	385-482	294	11130	EVY 2:1 Mix	3101	10401	401	10441	
.1	.5	-2	2										
.5	1.2	-6	8										
1.2	2.6	-5	7										

082036

DIP				LINE	SP's	DP's	XREF	ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORDS & GATHERS	REMARKS
Time	Dip												
0	0.1	0	0	H04-43	1-97	294	11130	EVY 2:1 Mix	3001	10001	1	10041	
0.1	0.5	-3	+3										
0.5	1.2	-3	+3										
1.2	2.6	-5	+7										
2.6	5.0	-6	+8										
0	0.1	0	0	H04-43	96-193	294	11130	EVY 2:1 Mix	3101	10101	101	10141	
0.1	0.5	-2	+2										
0.5	1.2	-6	+2										
1.2	2.6	-7	+3										
2.6	5.0	-7	+5										
0	0.1	0	0	H04-43	192-289	294	11130	EVY 2:1 Mix	3201	10201	201	10241	
0.1	0.5	-2	+2										
0.5	1.2	-6	+2										
1.2	2.6	-6	+3										
2.6	5.0	-6	+5										
0	0.1	0	0	H04-43	288-388	270	11130	EVY 2:1 Mix	3301	10301	301	10341	
0.1	0.5	-3	+3										
0.5	1.2	-4	+6										
1.2	2.6	-5	+5										
2.6	5.0	-14	+6										

082038

DIP				LINE	SP's	DP's	XREF	ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORDS GATHERS	REMARKS
Time	Dip												
0	.1	0	0	H04-47	1-981	294	11062	EVY 2:1 Mix	3001	10001	1	10041	
.1	.5	-3	3										
1.5	1.0	-7	15										
1.0	3.0	-15	5										
3.0	5.0	-11	4										
0	.1	0	0	H04-47	97-194	294	11062	EVY 2:1 Mix	3101	10101	101	10141	
.1	.5	-2	2										
.5	1.0	-10	15										
1.0	3.0	-7	4										
3.0	5.0	-5	5										
0	.1	0	0	H04-47	193-222	87	11062	EVY 2:1 Mix	3201	10201	201	10241	
.1	.5	-2	2										
.5	1.0	-3	3										
1.0	3.0	-4	4										
3.0	5.0	-7	5										
0	.5	0	0	H04-99	1-981	294	11000	EVY 2:1 Mix	3621	10701	701	10741	
.5	1.2	-12	7										
1.2	2.0	-10	5										
2.0	3.5	-14	7										
3.5	5.0	-12	10										
0	.5	0	0	H04-99	97-194	294	11000	EVY	3401	10401	401	10441	
.5	1.2	-12	10										
1.2	2.0	-10	5										
2.0	3.5	-14	7										
3.5	5.0	-12	10										

082039

Dip				LINE	SP's	DP's	XREF		ALT Evy	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORDS & GATHERS	REMARKS
Time	Dip													
0 1.9	0	0		H04-57	1-87	261	11130		Evy 2:1 Mix	3001	10001	1	10041	
1.9 2.61	-2	4												
2.61 4.5	-10	11												
4.5 7.0	-11	13												
0 1.5	0	0		H04-57	126-223	294	11130		Evy 2:1 Mix	3101	10101	101	10141	
1.5 2.61	-4	12												
2.61 4.5	-13	5												
4.5 7.0	-9	14												
0 1.1	0	0		H04-57	222-293	222	11130		Evy 2:1 Mix	3201	10201	201	10241	
1.1 2.61	-7	5												
2.61 4.5	-7	13												
4.5 7.0	-10	15												
0 0.3	0	0		H04-57	292-389	294	11130		Evy 2:1 Mix	3301	10301	301	10341	082041
0.3 1.2	-2	10												
1.2 3.0	-5	15												
3.0 5.0	-5	15												
5.0 7.0	-5	16												
0 0.15	0	0		H04-57	388-485	294	11130		Evy	3401	10401	401	10441	
0.15 1.0	-9	9												
1.0 2.61	-10	10												
2.61 4.0	-7	11												

DIP				LINE	SP's	DP's	XREF	ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORD & GATHERS	REMARKS
Time	Dip												
0	1.8	0	0	H04-36	1-55	118	11130	EVY 2:1 Mix	3001	10001	1	10041	
1.8	3.0	-5	17										
3.0	4.5	-20	20										
4.5	6.0	-16	16										
0	.6	0	0	H04-34	1-132	264	11130	EVY 2:1 Mix	3015	10101	101	10141	
.6	2.5	-21	17										
2.5	4.0	-27	12										
4.0	6.0	-25	14										
0	.5	0	0	H04-76	1-111	222	11130	EVY 2:1 Mix	3031	10201	201	10241	
.5	1.8	-2	+9										
1.8	3.5	-3	15										
3.5	5.0	-5	17										
0	2	0	0	H04-37	1-119	238	11130	EVY 2:1 Mix	3051	10301	301	10341	082043
2	3	-15	12										
3	5	-12	14										
5	7	-17	17										
0	1	0	0	H04-83	1-103	324	11130	EVY 2:1	3061	10401	401	10441	
.1	.5	-2	2										
.5	1.2	-3	7										
1.2	2.6	-6	8										

DIP				LINE	SP's	DP's	XREF			ALT Evy	WORK FILES	SUMMARY FILES	CONSQL FILES	HEADER RECORD & GATHERS	REMARKS
Time	Dip														
0	.1	0	0	H04-52	1-98	294	11130			Evy 2:1 Mix	3111	10501	501	10541	
.1	.5	-2	2												
.5	1.2	-3	11												
1.2	2.6	-13	13												
2.6	5.0	-10	26												
0	0	0	0	H04-52	97-216	360	11130			Evy 2:1 Mix	3131	10601	601	10641	
.1	.5	-2	2												
.5	1.2	-8	7												
1.2	2.6	-9	7												
2.6	5.0	-8	14												
										Evy 2:1 Mix					
										Evy 2:1 Mix					
										Evy 2:1 Mix					
										Evy 2:1 Mix					

082044

DIP				LINE	SP's	DP's	XREF	VCO	TCO	ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORD & GATHERS	REMARKS
TIME	DIP														
0	1.3	0	0	H04 - 94	1 - 168					ALT			1		
1.3	2.6	-8	10												
2.6	4.0	-8	4												
4.0	6.0	-3	17												
0	1.5	0	0	H04 - 94	169 - 336					ALT			101		
1.5	2.6	-7	10												
2.6	4.0	-4	6												
4.0	6.0	-12	12												
0	1.7	0	0	H04 - 94	337 - 504					ALT			201		
1.7	2.6	-5	8												
2.6	4.0	-6	6												
4.0	7.0	-11	10												
0	1.7	0	0	H04 - 94	505 - 672					ALT			301		082045
1.7	3.0	-10	5												
3.0	4.5	-9	9												
4.5	7.0	-5	4												
0	1.8	0	0	H04 - 94	673 - 840								401		
1.8	3.0	-8	8												
3.0	5.0	-9	7												
5.0	7.0	-10	10												

DIP				LINE	SP's	DP's	XREF	VCO	TCO	ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORD & GATHERS	REMARKS
TIME	DIP														
0	0.8	0	0	H04 - 103	1 - 168					ALT			601		
0.8	2.0	-9	26												
2.0	3.5	-11	6												
3.5	6.0	-3	8												
0	1.2	0	0	H04 - 103	168 - 288					ALT			701		
1.2	2.4	-27	27												
2.4	3.7	-5	6												
3.7	6.0	-4	8												
0	1.8	0	0	H04 - 103	289 - 456					ALT			1001		
1.8	2.8	-11	15												
2.8	4.8	-4	7												
4.8	7.0	-8	9												
0	1.7	0	0	H04 - 103	457 - 624					ALT			1101		082047
1.7	2.9	-23	9												
2.9	4.8	-16	15												
4.8	7.0	-9	8												
0	1.7	0	0	H04 - 103	625 - 680								1201		
1.7	2.9	-4	8												
2.9	4.8	-12	3												
4.8	7.0	-7	12												

DIP				LINE	SP's	DP's	XREF	VCO	TCO	ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORD & GATHERS	REMARKS
TIME	DIP														
0	0.1	0	0	H04 - 88	1 - 96					ALT			1		
0.1	0.5	-2	2												
0.5	1.2	-2	3												
1.2	2.6	-5	5												
2.6	5.0	-12	8												
0	0.1	0	0	H04 - 88	97 - 192					ALT			101		
0.1	0.5	-2	2												
0.5	1.2	-2	4												
1.2	2.6	-5	4												
2.6	5.0	-5	12												
0	0.1	0	0	H04 - 88	193 - 288					ALT			201		
0.1	0.5	-2	2												
0.5	1.2	-2	3												
1.2	2.6	-4	5												
2.6	5.0	-6	8												
0	0.1	0	0	H04 - 88	289 - 384					ALT			301		082048
0.1	0.5	-2	2												
0.5	1.2	-3	4												
1.2	2.6	-7	4												
2.6	5.0	-6	7												
0	0.1	0	0	H04 - 88	385 - 480								401		
0.1	0.5	-2	2												
0.5	1.2	-2	2												
1.2	2.6	-5	4												
2.6	5.0	-4	8												

DIP				LINE	SP's	DP's	XREF	VCO	TCO	ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORD & GATHERS	REMARKS
TIME	DIP														
0	0.1	0	0	H04 - 88	481 - 576					ALT			501		
0.1	0.5	-2	2												
0.5	1.2	-3	2												
1.2	2.6	-4	8												
2.6	5.0	-10	5												
0	0.1	0	0	H04 - 88	577 - 672					ALT			601		
0.1	0.5	-2	2												
0.5	1.2	-3	2												
1.2	2.6	-10	4												
2.6	5.0	-7	8												
0	0.1	0	0	H04 - 88	673 - 742					ALT			701		
0.1	0.5	-2	2												
0.5	1.2	-4	5												
1.2	2.6	-5	6												
2.6	5.0	-3	8												
										ALT					082049

DIP				LINE	SP's	DP's	XREF	VCO	TCO	ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORD & GATHERS	REMARKS
TIME	DIP														
0	0.1	0	0	H04 - 84A	1 - 48					ALT			1		
0.1	0.7	-4	4												
0.7	1.3	-6	4												
1.3	2.7	-8	6												
2.7	5.0	-6	8												
0	0.1	0	0	H04 - 84A	49 - 96					ALT			101		
0.1	0.7	-4	4												
0.7	1.3	-6	4												
1.3	2.7	-8	6												
2.7	5.0	-6	8												
0	0.1	0	0	H04 - .84A	97 - 144					ALT			201		
0.1	0.7	-4	4												
0.7	1.3	-6	4												
1.3	2.7	-8	6												
2.7	5.0	-6	8												
0	0.1	0	0	H04 - 84A	145 - 192					ALT			301		082050
0.1	0.7	-4	4												
0.7	1.3	-6	4												
1.3	2.7	-8	6												
2.7	5.0	-6	8												
0	0.1	0	0	H04 - 84A	193 - 230								401		
0.1	0.7	-4	4												
0.7	1.3	-6	4												
1.3	2.7	-8	6												
2.7	5.0	-6	8												

DIP				LINE	SP's	DP's	XREF	ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORDS & GATHERS	REMARKS
Time	Dip												
.0	.1	0	0	H04-50	224-321	294	11130	EVY 2:1 Mix	3001	10001	1	10041	
.1	.5	-2	2										
.5	1.2	-3	3										
1.2	2.6	-7	12										
2.6	5.0	-8	15										
.0	.1	0	0	H04-50	320-417	294	11130	EVY 2:1 Mix	3021	10101	101	10141	
.1	.5	-2	2										
.5	1.2	-7	4										
1.2	2.6	-4	13										
2.6	5.0	-8	8										
.0	.1	0	0	H04-50	416-519	306	11130	EVY 2:1 Mix	3041	01201	201	10241	
.1	.5	-2	2										
.5	1.2	-3	4										
1.2	2.6	-8	4										
2.6	5.0	-13	14										
.0	.1	0	0	H04-92	1-98	294	11130	EVY 2:1 Mix	3061	10301	301	10341	
.1	.5	-2	2										
.5	1.2	-3	3										
1.2	2.6	-7	5										
2.6	5.0	-10	7										
.0	.1	0	0	H04-92	97-194	294	11130	EVY 2:1 Mix	3101	10401	401	10441	
.1	.5	-2	2										
.5	1.2	-4	3										
1.2	2.6	-5	5										

082052

DIP				LINE	SP's	DP's	XREF			ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORDS & GATHERS	REMARKS
Time	Dip														
.0	.1	0	0	H04-92	193-294	306	11130			EVY 2:1 Mix	3121	10501	501	10541	
.1	.5	-2	2												
.5	1.2	-4	3												
1.2	2.6	-7	11												
2.6	5.0	-16	12												
0	.1	0	0	H04-73	1-98	294	11130			EVY 2:1 Mix	3201	10601	601	10641	
.1	.5	-2	2												
.5	1.2	-2	5												
1.2	2.6	-13	12												
2.6	5.0	-5	12												
0	.1	0	0	H04-73	97-194	294	11130			EVY 2:1 Mix	3301	10701	701	10741	
.1	.5	-2	2												
.5	1.2	-5	2												
1.2	2.6	-13	5												
2.6	5.0	-8	7												
.0	.1	0	0	H04-73	193-290	294	11130			EVY 2:1 Mix	3401	11001	1001	11041	082053
.1	.5	-2	2												
.5	1.2	-5	5												
1.2	2.6	-11	7												
2.6	5.0	-13	5												
0	.1	0	0	H04-73	289-365	231	11130			EVY 2:1 Mix	3501	11101	1101	11141	
.1	.5	-2	2												
.5	1.2	-5	2												
1.2	2.6	-9	2												
2.6	5.0	-9	2												

DIP				LINE	SP's	DP's	XREF	ALT EVY	WORK SUMMARY FILES	CONSOL FILES	HEADER RECORDS GATHERS	REMARKS
Time	Dip											
0	0.1	0	0	H04-40	1-98	294	11130	EVY 2:1 Mix	3001	10001	1	10041
0.1	0.5	-2	2									
0.5	1.2	-7	2									
1.2	2.6	-5	4									
2.6	5.0	-4	10									
0	0.1	0	0	H04-40	97-140	120	11130	EVY 2:1 Mix	3101	10401	401	10441
0.1	0.5	-2	2									
0.5	1.2	-4	2									
1.2	2.6	-4	10									
2.6	5.0	-5	6									
0.1	0.5	-2	2	H04-95	1-98	294	11130	EVY 2:1 Mix	3041	10201	201	10241
0.5	1.2	-7	2									
1.2	2.6	-6	4									
2.6	5.0	-8	15									
0	0.1	0	0	H04-95	97-136	114	11130	EVY 2:1 Mix	3061	10301	301	10341
0.1	0.5	-2	2									
0.5	1.2	-6	2									
1.2	2.6	-5	6									
2.6	5.0	-3	7									
0	.1	0	0	H04-8	1-98	294	11130	EVY	3121	10501	501	10541
.1	.5	-2	2									
.5	1.2	-3	3									
1.2	2.6	-4	4									

082054

DIP				LINE	SP's	DP's	XREF			ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORDS & GATHERS	REMARKS
Time	Dip														
.0	0.1	0	0	H04-80	1-98	294	11462			EVY 2:1 Mix	3001	10001	1	10041	
0.1	0.5	-2	2												
0.5	1.2	-5	7												
1.2	2.6	-5	9												
2.6	5.0	-15	15												
.0	0.1	0	0	H04-80	97-194	294	11462			EVY 2:1 Mix	3021	10101	101	10141	
0.1	0.5	-2	2												
0.5	1.2	-3	3												
1.2	2.6	-5	8												
2.6	5.0	-13	11												
.0	0.1	0	0	H04-80	193-290	294	11462			EVY 2:1 Mix	3041	10201	201	10241	
0.1	0.5	-2	2												
0.5	1.2	-3	3												
1.2	2.6	-7	7												
2.6	5.0	-10	8												
.0	0.1	0	0	H04-80	289-386	294	11462			EVY 2:1 Mix	3061	10301	301	10341	082056
0.1	0.5	-2	2												
0.5	1.2	-4	3												
1.2	2.6	-12	7												
2.6	5.0	-10	7												
.0	0.1	0	0	H04-80	385-482	294	11462			EVY	3101	10401	401	10441	
0.1	0.5	-2	2												
0.5	1.2	-3	8												
1.2	2.6	-3	10												

Time		Dip		LINE	SP's	DP's	XREF			WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORDS GATHERS	REMARKS
0	1.3	0	0	H04-93	1-171	342	11130			3001	10001	1		
1.3	2.6	-5	10											
2.6	4.0	-3	13											
4.0	6.0	-9	16											
0	1.5	0	0	H04-93	169-339	342	11130			3021	10101	101		
1.5	2.6	-15	7											
2.6	4.0	-4	5											
4.0	6.0	-7	14											
0	1.4	0	0	H04-93	337-507	342	11130			3041	10201	201		
1.4	2.6	-10	15											
2.6	4.0	-5	9											
4.0	6.0	-11	7											
0	1.3	0	0	H04-93	505-542	104	11130			3061	10301	301		
1.3	2.6	-7	7											
2.6	4.0	-8	3											
4.0	6.0	-11	11											
0	.6	0	0	H04-35	1-99	198	11130			3101	10401	401	10441	
.6	2.6	-2	18											
2.6	4.0	-3	9											
4.0	6.0	-13	12											

ALT
E.V.Y.

E.V.Y
2:1
Mix

E.V.Y
2:1
Mix

E.V.Y
2:1
Mix

E.V.Y
2:1
Mix

E.V.Y

082058

DIP				LINE	SP's	DP's	XREF			WORK SUMMARY FILES	CONSOL FILES	HEADER RECORDS GATHERS	REMARKS	
Time	Dip													
0	0.1	0	0	H04-41	1-100	300	11130			EVY 2:1 Mix	3701	10701	701	10741
.1	0.6	-3	3											
.6	1.2	-3	3											
.2	2.6	-4	4											
.6	5.0	-8	7											
0	0.1	0	0	H04-62	1-103	309	11130			EVY 2:1 Mix	4001	11001	1001	11041
.1	0.5	-3	3											
.5	1.2	-6	6											
.2	2.6	-8	7											
.6	5.0	-10	7											
0	.1	0	0	H04-65	1-98	294	11130			EVY 2:1 Mix	3001	10001	1	10041
.1	1.0	-2	12											
.0	1.5	-4	10											
.5	2.6	-2	8											
.6	5.0	-8	13											
0	0.1	0	0	H04-65	97-194	294	11130			EVY 2:1 Mix	3101	10101	101	10141
.1	0.5	-2	2											
.5	1.2	-3	3											
.2	2.6	-2	8											
.6	5.0	-9	10											
0	0.1	0	0	H04-65	193-290	294	11130			EVY 2:1	3201	10201	201	10241
.1	0.5	-2	2											
.5	1.2	-3	4											
.2	2.6	-15	8											
.6	5.0	-5	13											

EVY
2:1
Mix

082060

DIP				LINE	SP's	DP's	XREF	ALT EVY	WORK SUMMARY FILES	CONSOL FILES	HEADER RECORDS GATHERS	REMARKS
Time	Dip											
0	100	0	0	H04-96	1-98	294	10960	EVY 2:1 Mix	3001	10001	1	10041
00	500	-3	+3									
00	1000	-4	4									
000	3000	-7	7									
000	5000	-10	4									
0	100	0	0	H04-96	97-194	294	10960	EVY 2:1 Mix	3101	10101	101	10141
00	500	-3	3									
00	1000	-7	4									
000	3000	-8	15									
000	5000	-10	7									
0	100	0	0	H04-96	193-240	144	10960	EVY 2:1 Mix	3201	10201	201	10241
00	500	-3	3									
00	1000	-8	4									
000	3000	-8	5									
000	5000	-10	7									
0	1.0	0	0	H04-100	1-98	294	11000	EVY 2:1 Mix	3301	10301	301	10341
.0	2.2	-8	5									
.2	3.4	-6	6									
.4	4.4	-8	8									
.4	6.0	-6	8									
0	.7	0	0	H04-100	97-194	294	11000	EVY 2:1	3401	10401	401	10441
.7	1.2	-6	8									
.2	2.2	-10	10									
.2	3.4	-10	10									
.4	5.0	-12	8									

082062

DIP				LINE	SP's	DP's	XREF	ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORDS GATHERS	REMARKS
Time	Dip												
0	.7	0	0	H04-100	193-232	120	11000	EVY 2:1 Mix	3501	10501	501	10541	
.7	1.2	-6	8										
.2	2.2	-10	10										
.4	5.0	-12	8										
0	.3	0	0	H04-98	1-98	294	11130	EVY 2:1 Mix	3601	10601	601	10641	
.3	.7	-8	3										
.7	1.2	-7	10										
.2	2.6	-10	10										
.6	5.0	-9	7										
0	.3	0	0	H04-98	97-194	294	11130	EVY 2:1 Mix	3701	10701	701	10741	
.3	.7	-7	9										
.7	1.2	-8	11										
.2	2.6	-9	10										
.6	5.0	-9	15										
0	.3	0	0	H04-98	193-240	144	11130	EVY 2:1 Mix	4001	11001	1001	11041	
.3	.7	-9	7										
.7	1.2	-11	10										
.2	2.6	-11	10										
.6	5.0	-12	15										
								EVY 2:1					

082063

DIP				LINE	SP's	DP's	XREF	ALT EVY	WORK SUMMARY FILES	CONSOL FILES	HEADER RECORDS GATHERS	REMARKS
Time	Dip											
0	0.1	0	0	H04-3	1-98	294	11330	EVY 2:1 Mix	3001	10001	1	10041
0.1	0.5	-2	2									
0.5	1.2	-2	4									
1.2	2.65	-8	3									
2.65	5.0	-12	7									
0	0.1	0	0	H04-3	97-194	294	11330	EVY 2:1 Mix	3101	10101	101	10141
0.1	0.5	-2	2									
0.5	1.2	-3	4									
1.2	2.65	-6	4									
2.65	5.0	-9	13									
0	0.1	0	0	H04-3	193-290	294	11330	EVY 2:1 Mix	3201	10201	201	10241
0.1	0.5	-2	2									
0.5	1.2	-3	5									
1.2	2.65	-5	6									
2.65	5.0	-13	10									
0	0.1	0	0	H04-3	289-338	150	11330	EVY 2:1 Mix	3301	10301	301	10341
0.1	0.5	-2	2									
0.5	1.2	-4	4									
1.2	2.65	-4	7									
2.65	5.0	-7	10									
0	0.1	0	0	H04-90	1-98	294	11130	EVY	3401	10401	401	10441
0.1	0.5	-2	2									
0.5	1.2	-3	4									
1.2	2.6	-7	4									
2.6	5.0	-11	11									

082064

DIP				LINE	SP's	DP's	XREF	VCO	TCO	ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORD & GATHERS	REMARKS
TIME	DIP														
0	0.1	0	0	H04 - 90	97 - 176					ALT			501		
0.1	0.5	-2	2												
0.5	1.2	-4	4												
1.2	2.6	-8	10												
2.6	5.0	-13	13												
0	1.7	0	0	H04 - 84B	505 - 648					ALT			1201		
1.7	2.6	-2	10												
2.6	4.5	-10	14												
4.5	7.0	-15	8												
0	1.5	0	0	H04 - 38	1 - 48					ALT			701		
2	3	-18	15												
3	5	-15	16												
5	7	-20	20												
0	1.2	0	0	H09 - 38	49 - 102					ALT			1001		
1.2	3	-18	15												
3	5	-15	16												
5	7	-20	20												
0	1.2	0	0	H04 - 38	97 - 216								1101		
1.2	2.6	-7	10												
2.6	4.0	-13	7												
4.0	6.0	-13	15												

082065

DIP				LINE	SP's	DP's	XREF	ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORDS & GATHERS	REMARKS
Time	Dip												
0	.4	0	0	H04-81	1-98	294	11130	EVY 2:1 Mix	3001	10001	1	10041	
.4	1.2	-8	22										
1.2	1.85	-5	14										
1.85	2.6	-5	16										
2.6	5.0	-15	21										
0	.1	0	0	H04-81	97-194	294	11130	EVY 2:1 Mix	3021	10101	101	10141	
.1	.5	-2	9										
.5	1.2	-10	13										
1.2	2.6	-8	14										
2.6	5.0	-10	15										
0	.1	0	0	H04-81	193-290	294	11130	EVY 2:1 Mix	3041	10201	201	10241	
.1	.5	-2	2										
.5	1.2	-3	5										
1.2	2.6	-8	6										
2.6	5.0	-11	7										
0	.1	0	0	H04-81	289-386	294	11130	EVY 2:1 Mix	3061	10301	301	10341	
.1	.5	-2	2										
.5	1.2	-3	3										
1.2	2.6	-11	+14										
2.6	5.0	-12	16										
0	.1	0	0	H04-81	385-482	294	11130	EVY 2:1	3101	10401	401	10441	
.1	.5	-2	2										
.5	1.2	-3	3										
1.2	2.6	-15	10										
2.6	5.0	-10	10										

082066

DIP				LINE	SP's	DP's	XREF	VCO	TCO	ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORD & GATHERS	REMARKS
TIME	DIP														
0	1.45	0	0	H04-102	1 - 168					ALT			201		
1.45	2.6	-20	11												
2.6	4.0	-24	9												
4.0	6.0	-14	19												
0	2.15	0	0	H04-102	169 - 336					ALT			301		
2.15	2.61	-10	5												
2.61	4.0	-9	15												
4.0	7.0	-7	20												
0	1.8	0	0	H04-102	337 - 408					ALT			401		
1.8	2.61	-18	12												
2.61	4.0	-10	7												
4.0	6.0	-22	10												
										ALT					

082069

DIP				LINE	SP's	DP's	XREF	VCO	TCO	ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORD & GATHERS	REMARKS
TIME	DIP														
0	0.2	0	0	H04 - 84B	1 - 48					ALT			1		
0.2	0.8	-6	6												
0.8	1.8	-6	8												
1.8	3.2	-12	8												
3.2	5.0	-8	8												
0	0.2	0	0	H04 - 84B	49 - 96					ALT			101		
0.2	0.8	-6	6												
0.8	1.8	-8	10												
1.8	3.2	-12	6												
3.2	5.0	-8	8												
0	0.2	0	0	H04 - 84B	97 - 144					ALT			201		
0.2	0.8	-6	6												
0.8	1.8	-6	8												
1.8	3.2	-9	8												
3.2	5.0	-8	8												
0	0.2	0	0	H04 - 84B	145 - 192					ALT			301		
0.2	0.8	-6	6												
0.8	1.8	-6	6												
1.8	3.2	-8	8												
3.2	5.0	-8	8												
0	0.2	0	0	H04 - 84B	193 - 240								401		
0.2	0.8	-6	8												
0.8	1.8	-8	10												
1.8	3.2	-10	10												
3.2	5.0	-10	10												

082070

DIP				LINE	SP's	DP's	XREF	VCO	TCO	ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORD & GATHERS	REMARKS
TIME	DIP														
0	0.2	0	0	H04-84B	241 - 288					ALT			501		
0.2	0.8	-6	8												
0.8	1.8	-8	10												
1.8	3.2	-8	14												
3.2	5.0	-12	12												
0	0.2	0	0	H04-84B	189 - 336					ALT			601		
0.2	1.0	-4	14												
1.0	2.2	-6	14												
2.2	3.5	-6	12												
3.5	5.0	-8	18												
0	0.5	0	0	H04-84B	337 - 384					ALT			701		
0.5	1.5	-6	14												
1.5	2.5	-6	14												
2.5	3.5	-6	12												
3.5	6.0	-8	14												
0	1.3	0	0	H04-84B	385 - 432					ALT			1001		
1.3	2.5	-6	10												
2.5	3.5	-8	10												
3.5	4.5	-8	10												
4.5	6.0	-10	10												
0	1.6	0	0	H04-84B	433 - 480								11141		
1.6	2.5	-6	10												
2.5	3.5	-8	10												
3.5	4.5	-8	10												
4.5	6.0	-10	10												

082071

DIP				LINE	SP's	DP's	XREF			WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORDS & GATHERS	REMARKS
Time	Dip													
0	0.1	0	0	H04-28	1-98	294	11130			EVI 2:1 Mix	3101	10401	401	10441
.1	0.5	-2	2											
.5	1.2	-10	6											
.2	2.6	-10	4											
.6	5.0	-6	6											
0	0.1	0	0	H04-37A	1-98	294	11130			EVI 2:1 Mix	3121	10501	501	10541
.1	0.5	-2	2											
.5	1.2	-2	5											
.2	2.6	-4	5											
.6	5.0	-7	8											
0	0.1	0	0	H04-37A	97-194	294	11130			EVI 2:1 Mix	3141	10601	601	10641
.1	0.5	-2	2											
.5	1.2	-2	4											
.2	2.6	-6	12											
.6	5.0	-8	16											
0	0.1	0	0	H04-37A	193-280	258	11130			EVI 2:1 Mix	3161	10701	701	10741
.1	0.5	-2	2											
.5	1.2	-7	5											
.2	2.6	-3	6											
.6	5.0	-9	8											
0	0.1	0	0	H04-14	1-98	294	11130			EVI 2:1	3201	11001	1001	11041
.1	0.5	-2	2											
.5	1.2	-2	5											
.2	2.6	-2	10											
.6	5.0	-8	8											

082072

DIP		LINE	SP's	DP's	XREF			ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORDS GATHERS	REMARKS
Time	Dip												
0: .1	0	H04-97	1-97	294	11000			EVY 2:1 Mix	3001	10001	1	10041	
.1: .5	-2												
.5: 1.0	-8												
1.0: 3.0	-10												
3.0: 5.0	-10												
0: .1	0	H04-97	95-194	294	11000			EVY 2:1 Mix	3021	10101	101	10141	
.1: .5	-2												
.5: 1.0	-7												
1.0: 3.0	-5												
3.0: 5.0	-10												
0: .1	0	H04-97	193-290	294	11000			EVY 2:1 Mix	3041	10201	201	10241	
.1: .5	-2												
.5: 1.0	-12												
1.0: 3.0	-14												
3.0: 5.0	-10												
0: .1	0	H04 58	1-97	294	11150			EVY 2:1 Mix	3061	10301	301	10341	
.1: .9	-5												
.9: 1.7	-4												
1.7: 3.4	-10												
3.4: 5.0	-10												
0: .3	0	H04-58	95-148	150	11150			EVY 2:1	3101	10401	401	10441	
.3: 1.5	-4												
1.5: 2.2	-4												
2.2: 3.4	-10												
3.4: 5.0	-10												

082074

DIP		LINE	SP's	DP's	XREF			ALT EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORDS GATHERS	REMARKS
Time	Dip												
0 : .6	0 | 0	H04-58	146-196	150	11150			EVY 2:1 Mix	3121	10501	501	10541	
.6 : 1.5	-4 | 10												
1.5 : 2.2	-4 | 8												
2.2 : 3.4	-10 | 12												
3.4 : 5	-8 | 12												
0 : 1.5	0 | 0	H04-58	194-244	222	11150			EVY 2:1 Mix	3141	10601	601	10641	
.5 : 2.5	-6 | 10												
.5 : 3.4	-8 | 8												
.4 : 4.5	-10 | 12												
.5 : 6.0	-10 | 12												
0 : .1	0 | 0	H04-97	289-359	211	11000			EVY 2:1 Mix	3161	10701	701	10741	
.1 : .5	-2 | 2												
.5 : 1.0	-12 | 9												
.0 : 3.0	-9 | 7												
.0 : 5.0	-4 | 9												
								EVY 2:1 Mix					
								EVY 2:1					

082075

Dip				LINE	SP's	DP's	XREF			ALT EVI	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORD GATHERS	REMARKS
Time	Dip														
0	1.8	0	0	H04-84B	631-753	246	10936			EVI 2:1 Mix	3001	10001	1	10041	
.8	3.0	-3	5												
3.0	4.5	-10	15												
5.5	7.0	-15	15												
0	2.0	0	0	H04-84B	751-873	246	10936			EVI 2:1 Mix	3101	10101	101	10141	
2.0	3.2	-3	8												
3.2	5.0	-10	15												
5.0	7.0	-10	10												
0	2.2	0	0	H04-84B	871-993	246	10936			EVI 2:1 Mix	3201	10201	201	10241	
2.2	3.3	-3	8												
3.3	5.0	-10	15												
5.7	7.0	-12	15												
0	2.5	0	0	H04-84B	991-1137	294	11018			EVI 2:1 Mix	3301	10301	301	10341	
2.5	3.5	-3	8												
3.5	5.5	-8	20												
5.5	7.0	-5	20												
0	2.9	0	0	H04-84B	1135-1233	198	11032			EVI 2:1	3401	10401	401	10441	
2.9	4.1	-5	8												
4.1	6.0	-10	15												
5.0	8.0	-20	16												

082076

DIP		LINE	SP's	DP's	XREF			EVY	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORDS & GATHERS	REMARKS
Time	Dip												
0:3.3	0	H04-84B	1231-1353	246	11032			EVY 2:1 Mix	3501	10501	501	10541	
3:3.4.5	-10												
5:6.0	-10												
0:8.0	-13												
0:3.6	0	H04-84B	1351-1473	246	11032			EVY 2:1 Mix	3601	10601	601	10641	
6:4.8	-3												
8:6.0	-3												
0:8.0	-8												
0:4.0	0	H04-84B	1471-1593	246	11032			EVY 2:1 Mix	3701	10701	701	10741	
0:5.0	-3												
0:6.5	-6												
5:8.0	-8												
0:4.3	0	H04-84B	1591-1638	96	11032			EVY 2:1 Mix	4001	11001	1001	11041	
3:5.2	-3												
2:6.5	-3												
5:8.0	-11												
								EVY 2:1					

082077

DIP				LINE	SP's	DP's	XREF			ALT EVI	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORD GATHERS	REMARKS
Time	Dip														
0	.1	0	0	H04-12	1-98	294	11130			EVI 2:1 Mix	3001	10001	1	10041	
.1	.5	-2	4												
.5	1.2	-2	7												
.2	2.6	-8	10												
.6	5.0	-7	7												
0	.1	0	0	H04-12	97-194	294	11130			EVI 2:1 Mix	3021	10101	101	10141	
.1	.5	-2	2												
.5	1.2	-3	3												
.2	2.6	-6	6												
.6	5.0	-10	10												
0	.1	0	0	H04-12	193-230	114	11130			EVI 2:1 Mix	3044	10201	201	10241	
.1	.5	-2	2												
.5	1.2	-3	8												
1.2	2.6	-4	4												
2.6	5.0	-8	8												
0	.1	0	0	H04-13	1-98	294	11130			EVI 2:1 Mix	3061	10301	301	10341	
.1	.5	-2	6												
.5	1.2	-5	7												
1.2	2.6	-7	8												
2.6	5.0	-7	8												
0	.1	0	0	H04-13	97-182	258	11130			EVI 2:1	3101	10401	401	10441	
.1	.5	-2	2												
.5	1.2	-3	4												
1.2	2.6	-5	9												
2.6	5.0	-6	7												

DIP				LINE	SP's	DP's	XREF			LIMIT	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORDS GATHERS	REMARKS
Time	Dip														
0	.1	0	0	H04-87	1-98	294	11130			EY	3121	10501	501	10541	
.1	.5	-5	7												
.5	1.2	-7	8												
.2	2.6	-9	7												
.6	5.0	-10	20												
0	.1	0	0	H04-87	97-212	330	11130			EY	3141	10601	601	10641	
.1	.5	-2	2												
.5	1.2	-3	7												
.2	2.6	-15	9												
.6	5.0	-8	9												
0	.1	0	0	H04-86	1-98	294	11130			EY	3161	10701	701	10741	
.1	.5	-2	2												
.5	1.2	-3	3												
.2	2.6	-5	5												
.6	5.0	-13	7												
0	.1	0	0	H04-86	97-194	294	11130			EY	3201	11001	1001	11041	
.1	.5	-2	2												
.5	1.2	-8	5												
.2	2.6	-10	8												
.6	5.0	-12	17												
0	.1	0	0	H04-86	193-290	294	11130			EY	3221	11101	1101	11141	
.1	.5	-2	2												
.5	1.2	-3	8												
.2	2.6	-3	8												
.6	5.0	-10	12												

082079

DIP				LINE	SP's	DP's	XREF			EVT EVT	WORK FILES	SUMMARY FILES	CONSOL FILES	HEADER RECORDS GATHERS	REMARKS
Time	Dip														
0	1.3	0	0	H04-89	1-171	342	11130			EVT 2:1 Mix	3001	10001	1	10041	
.3	2.3	-10	7												
.3	3.5	-4	6												
.5	6.0	-14	14												
0	1.4	0	0	H04-89	169-339	342	11130			EVT 2:1 Mix	3021	10101	101	10141	
.4	2.6	-22	17												
.6	3.8	-3	5												
.8	6.0	-14	16												
0	1.4	0	0	H04-89	337-507	342	11130			EVT 2:1 Mix	3041	10201	201	10241	
.4	2.6	-13	10												
.6	3.8	-7	5												
.8	6.0	-12	14												
0	1.5	0	0	H04-89	505-675	342	11130			EVT 2:1 Mix	3061	10301	301	10341	
.5	2.6	-12	7												
.6	3.8	-5	3												
.8	6.0	-17	9												
0	1.6	0	0	H04-89	673-843	342	11130			EVT 2:1	3101	10401	401	10441	
.6	2.7	-12	21												
.7	3.8	-16	8												
.8	6.0	-7	16												

082081

OP			LINE	SP's	DP's	XREF			EVAL EVAL	WORK FILES	SUMMARY FILES	CONSL FILES	HEADER RECORD GATHERS	REMARKS
Time	Dip													
0:1.6	0	0	H04-89	841-959	238	11130			EVAL 2:1 Mix	3121	10501	501	10541	
.6:2.7	-4	16												
.7:4.0	-4	4												
.0:6.0	-13	13												
0:1.0	0	0	H04-91	1-171	342	11130		EVAL 2:1 Mix	3141		601			
.0:2.5	-15	25												
.5:4.0	-15	8												
.0:6.0	-9	16												
0:1.0	0	0	H04-91	169-339	342	11130		EVAL 2:1 Mix	3161		701			
.0:2.5	-25	20												
.5:4.0	-10	16												
.0:6.0	-17	25												
0:0.7	0	0	H04-91	337-507	342	11130		EVAL 2:1 Mix	3201		1001			
.7:2.5	-25	20												
.5:4.0	-15	13												
.0:6.0	-15	17												
								EVAL 2:1						

082082

082083



HEMATITE PETROLEUM PTY. LTD.
OTWAY HO4 MARINE SEISMIC SURVEY
GEOPHYSICAL SERVICE INTERNATIONAL PARTY 931

5 cm

PLATE I

**OTWAY/KING PART-IX***

OPERATIONS REPORT,
MARINE SEISMIC SURVEY,
OTWAY BASIN,

H04

For

HEMATITE PETROLEUM PROPRIETARY LIMITED
BHP HOUSE,
140 William Street
MELBOURNE VICTORIA 3000

Mr. J. Denham

By

GEOPHYSICAL SERVICE INTERNATIONAL
P.O. Box 437,
CROWS NEST NSW 2065

Party 931 M.V. "EUGENE McDERMOTT II"
Operations Supervisor : G. Shilliday
Quality Control :
Seismologists: T.O'Donnell, S. Williams

16th November - 1st December 1974



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B	EQUIPMENT a) Recording b) Vessel
C	OPERATION STATISTICS
D	FIELD TAPE LOG

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1	LOCATION OF PROSPECT
2	CABLE AND SPREAD ARRANGEMENT (3200 METRE STREAMER)
3	AIRGUN ARRAY
4	AIRGUN PULSE AND SPECTRUM
5	TAPE FORMAT

081-708



HEMATITE PETROLEUM PTY. LTD.
LOCATION OF PROSPECT
OTWAY BASIN
GEOPHYSICAL SERVICE INTERNATIONAL

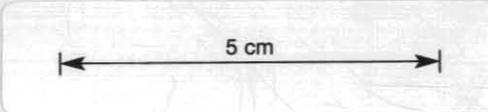
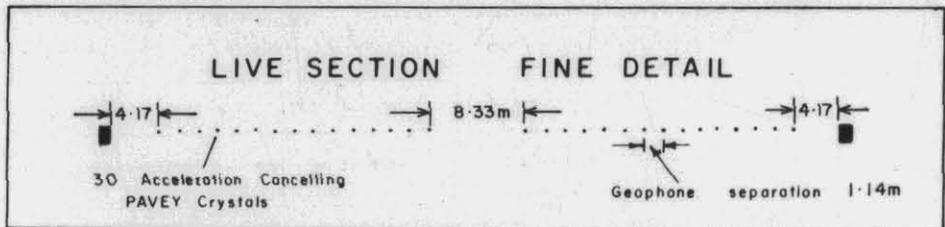
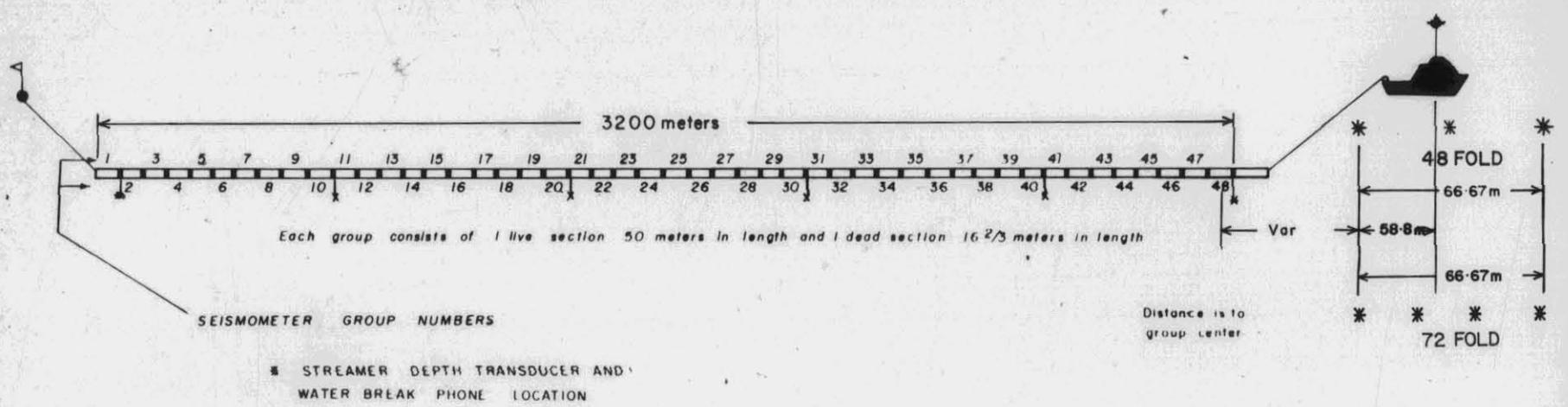


PLATE I

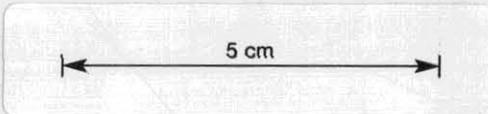
082087



082088



WATER BREAKS	DISPLAYED ON SEISMOGRAM TRACES	RECORDED ON TAPE CHANNELS
1	53/54	27
2	51/52	26
3	49/50	25
4	53/54	27
5	51/52	26
6	49/50	25



MARINE CABLE DIAGRAM
3200 METER

(OFF END SPREAD - 48 GROUPS)

G. S. I. Party 931

Ship M/V "EUGENE McDERMOTT II"

Client HEMATITE

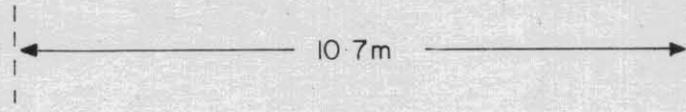
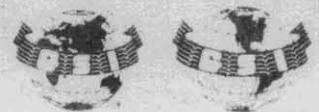
Area OTWAY BASIN

Date NOV/DEC, 1974

082088



PLATE 2



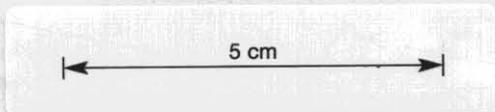
N°	GUN	SIZE	Distances		N°	GUN	SIZE
			— 0m —				
1	●	1.311 litres	— 0m —		17	●	1.639 litres
2	●	1.311		0.46	18	●	1.639
3	●	1.311		0.91	19	●	1.639
4	●	1.311		1.37	20	●	1.639
5	●	1.639	3.20	3.28	21	●	1.639
6	●	1.639	3.66	3.73	22	●	1.639
7	●	1.311	5.49	5.64	23	●	1.311
8	●	1.311	5.94	6.10	24	●	1.311
9	●	0.655	7.77	8.00	25	●	0.655
10	●	0.655	8.99	9.30	26	●	0.655
11	●	0.655	10.21	10.59	27	●	0.655
12	●	0.328	11.43	11.89	28	●	0.328
13	●	0.328	12.65	13.11	29	●	0.328
14	●	0.328	13.87	14.33	30	●	0.328
15	●	0.164	15.09	15.54	31	●	0.164
16	●	0.164	16.31	16.76	32	●	0.164

PORT

STARBOARD

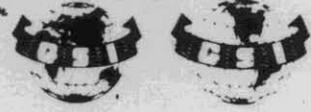
m/v EUGENE Mc DERMOTT II

AIR GUN ARRAY

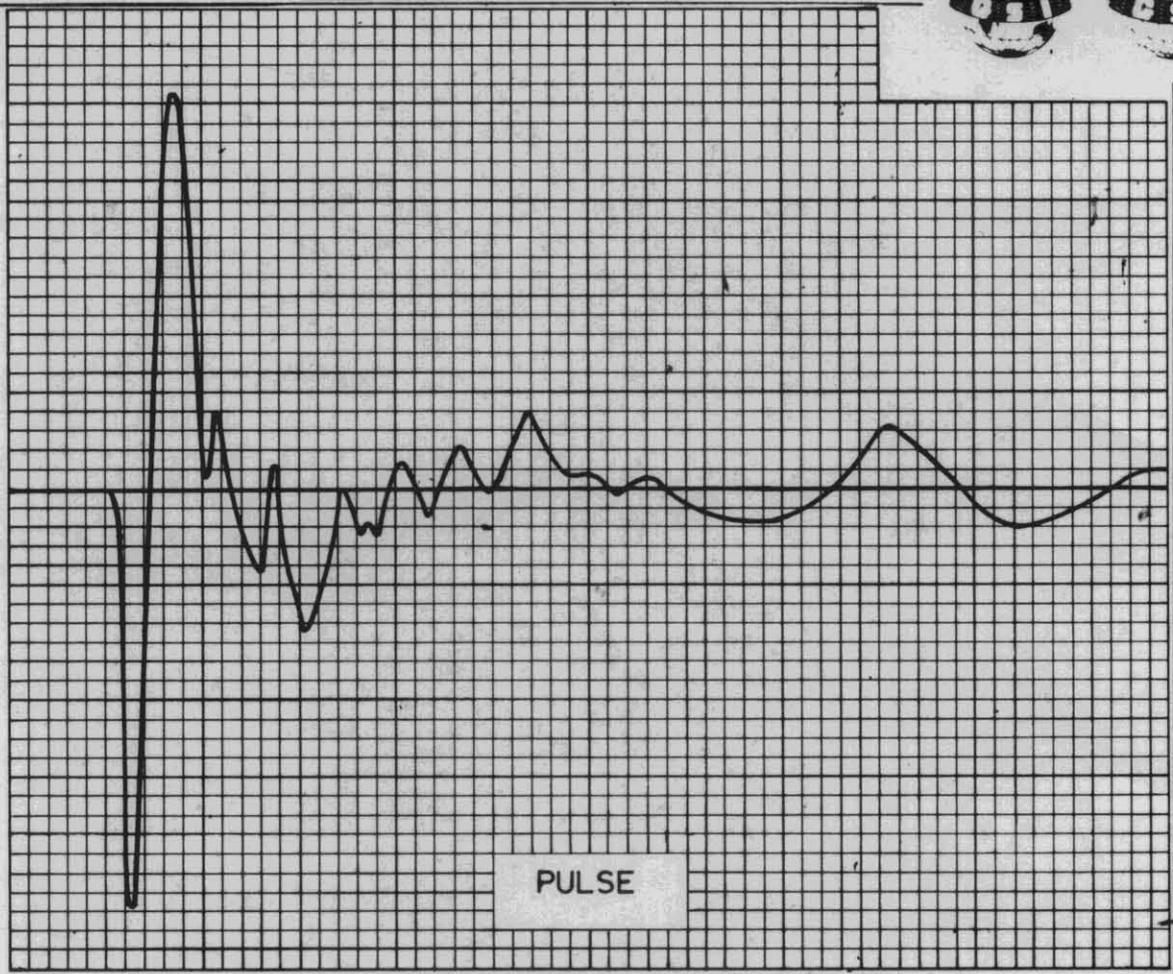


5 cm

082090



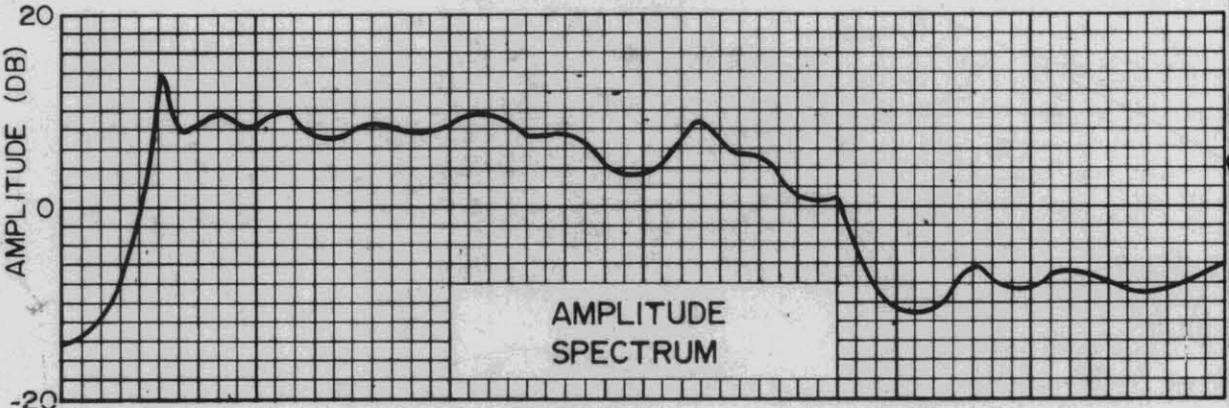
AMPLITUDE



0 100 200 MILLISECONDS

RELATIVE

AMPLITUDE (DB)



0 20 40 60 80 100 FREQUENCY (HZ)

GUN	SIZES
4X0-164 litres	2X1-311 litres
6X0-328 "	2X1-639 "
6X0-655 "	1X3-278 "
	1X3-933 "

AIRGUN ARRAY PULSE AND SPECTRUM

Vessel EUGENE MCDERMOTT II
 Array Capacity 19.665 litres
 Recording Filter OUT - 248 Hz
 Date NOV/DEC, 1974



SECTION 1

INTRODUCTION

A marine seismic reflection survey was conducted by the M.V. "Eugene McDermott II" in the Otway Basin area for Hematite Petroleum Pty Ltd., between 16th November and 1st December 1974.

Approximately 1272 kilometres of 72 - fold reflection coverage and 97 kilometres of 48 fold reflection coverage were shot utilizing a 3200 metre streamer under continuous tow in conjunction with a Pneumatic Acoustic Energy Source (Airguns), generally operating 24 hours per day.

These figures also included approximately 81 kilometres of single trace refractive coverage, collected through the use of Aquatronics SB-68 sonobuoys, and approximately 23 kilometres of onshore connection covered by two Aquatronics Telseis units.

Recordings were made using two sets of 24 trace DFS III's, with three tape transports recording on 25.4 mm magnetic tape in 21 track TIAC* Binary Gain Digital Format. Record length varied from five seconds to eleven seconds mainly according to water depth. In all instances the sample rate was four milliseconds.

The ship's location was primarily determined by XR Shoran, with Geonav * employed in the secondary, or back up role, and for general navigation.

*Trademark of Texas Instruments Inc.



SECTION II

OPERATION PROCEDURES

A. RECORDING:

A Texas Instruments Digital Field System III (DFS III) with three tape transports was used for all recording. A Servo Writer Profiler was utilised to obtain 100% (Near Trace Gather) subsurface coverage (uncorrected section) of four second duration, directly from monitor recording.

Direct Read After Write (RAW) monitors were generated approximately every twenty shotpoints for quality control purposes.

B. STREAMER:

The 3200 metre, neutrally buoyant, continuous tow streamer consisted of 48 live sections each 50 metres in length and alternate dead sections, each 16.67 metres in length. Six Waterbreak/Depth Transducer sections each 1.83 metres in length, were located immediately in front of group 48 and between groups 41L and 40D, 31L and 30D, 21L and 20D, 11L and 10D, 2L and 1D.



Five and six nylon stretch sections were placed between group 48 and the recording vessel to attenuate ship generated noise. Four Condep** cable depth controllers were placed between the depth transducers on the streamer at the centre of live groups 5D, 15D, 25D, and 35D where the hydrophone spacing is the greatest.

One nylon stretch section followed group 1 and was joined to the tailbuoy by 122 metres of nylon rope. Tailbuoy bearings were taken by radar every 40 pops to ensure that maximum feathering angle was not exceeded.

The average streamer depth was 16.76 metres.

C. ENERGY SOURCE (AIRGUNS):

An Electro-Pneumatic Acoustic Energy Source known as "Airguns" was used for all reflection work.

**Trademark of Continental Oil Company



The airgun has basically two moving parts, the shuttle and the solenoid. Compressed air is supplied to this unit at a pressure of 13,780 kPa. The shuttle is forced to close on initial application of pressure. Compressed air fills the reservoir chamber through a central orifice in the shuttle. To discharge the gun an electrical current activates the solenoid and retracts a plunger, thus enabling compressed air to pass through a port hole to the underside of a flange at the top of the shuttle. The pressure difference above and below the shuttle then thrusts it open. The air from the chamber then escapes through four port holes near the centre of the gun and expands rapidly through the water, producing a single bubble and resultant shock wave. The air bubble collapses in a manner similar to that caused by explosives with one notable exception in that its period is controllable and is placed in the desired seismic frequency band.



There are three variables used to control the frequency content of the shock waves. These are: -

- i) depth of the airgun in the water,
- ii) pressure at which the gun is operated,
and
- iii) size of the chambers used on the gun.

Using different guns of various chamber sizes broadens and flattens the frequency spectrum of the pulse (Plate 4).

The depth of the airguns was 7.62 metres and they were operated at a pressure of 13,780 kPa with the pressure never falling below 12,400 kPa.

The individual airguns were arranged to produce an 19,665 litre array. This array consisted of:



- i) 4 x 0.164 litre guns
- ii) 6 x 0.328 litre guns
- iii) 6 x 0.655 litre guns
- iv) 2 x 1.311 litre guns
- v) 2 x 1.639 litre guns
- vi) 3 x 1.311 litre guns forming a
1 x 3.933 litre array
- vii) 2 x 1.639 litre guns forming a
1 x 3.278 litre array

These arrays were arranged and spaced so as to operate as a tuned array which yields a flat frequency spectrum.



The time co-ordinator unit triggered the Digital Field System which in turn discharged the Texas Instrument Airgun Control Unit (Blaster), causing a current to flow simultaneously through all solenoids, resulting in the guns firing. The guns were fired every 22.22 metres giving 72 fold coverage, and every 33.33 metres to give 48 fold coverage. The airgun array was mounted on two Gun Strings, one port astern and the other starboard astern and towed behind the recording vessel at a distance of 27.4 metres from the stern to the centre of the array.

D. INSTRUMENTS AND NOISE TESTS:

Instrument tests were carried out prior to each day's operations and the results were examined in an analog form in the field. These tests consisted of Dynamic Range Determination, Amplifier Noise Test and Automatic Gain Control (AGC) Test. Frequent checks on tape speed and skew were made.



A set of monthly tests were carried out prior to commencement of operations. These tests included Harmonic Distortion, Gain Linearity, Periodic Calibration checks, skew checks and the above-mentioned tests.

The tests were analysed in the Sydney, Australia Processing Centre using TIAC routines.

A streamer noise analysis was made at the beginning of each line shot. Some of these tests were recorded on tape.

E. FATHOMETER:

A Ross Model 400A fathometer and an Elac Deneb, Model LAZ-17DDL, AGN8 fathometer were used.

The Ross fathometer operated at 50 KHz and the Elac fathometer at 15-20 KHz. Each fathogram was identified by line number, direction shot, time and date of first shotpoints and scale.

The fathograms were marked every shotpoint and labelled at frequent intervals to facilitate interpretation. The zero line for the fathograms was not corrected for the ship's draught.



F. MAGNETOMETER:

The Varian proton magnetometer was utilised on two lines of this prospect, H04-84B and H04-11, with sensor tuning readings at 50-70 Kilogammas, and a manual polarize setting of A. For the most part, a general consistency in data collection was evident throughout both lines.

G. REFRACTION SURVEY:

Refraction data was collected on lines H04-84B, H04-97 and H04-99. Land connections were made on lines H04-84A and H04-86 with Telseis equipment owned and operated by Seismic Supply International of Brisbane. Coordination was provided by G.S.I.

Two Telseis units were operated, each consisting of a 24 multiple geophone array, and two Telseis transmitters (Model STT-70) which were established ashore.

Two receivers (Model TRM-70) were installed aboard the "Eugene McDermott", VHF Radio communications were maintained between ship and shore throughout all operational periods.

All instruments performed adequately and the resultant data obtained appeared satisfactory.



H. SURVEY:

The ship's position at every shotpoint was determined by XR Shoran, supplied and operated by Offshore Navigation Incorporated of Cloverdale, Perth. A separate report has been supplied.

Equipment calibration was carried out on the 15th of November, 1974. Six sets of base station equipment occupied station Mt. Warrnambool with the mobile equipment on station Mt. Richmond. All observed calibration readings were satisfactory and the equipment was accepted as functioning within its specifications.

Preplots were organised by G.S.I. through Engineering Computer Services of Chandos St., St. Leonards.

Postplots were also organised by G.S.I. through the same service bureau showing the position of the antenna, using observed range readings. By employing a 58.8 metre setback the position of the Centre line of the airgun array was determined and used in the preparation of final location maps at the scales of 1:100,000 and 1:250,000 in accordance with normal mapping parameters for that area of Australia, namely Australian National Spheroid, Universal Transverse Mercator Projection and Map Zone 54. One line, H04-84A, was processed using Geonav data as this system had assumed primary control at the Client's request.



Station pairs were selected so that all shotpoint fixes were made from range position line intersecting angles falling between 30 and 150 degrees.

I. PERMITTING:

Shore station site information was supplied by Geophysical Service International and radio navigation and communication licences were organised from the Radio Licencing branch of the P.M.G. in Melbourne. Permits to operate the Telseis equipment was organised by Seismic Supply International. The Marine Operations Centre, Canberra, was advised as to the ship's location throughout the survey to enable the necessary navigation warning to mariners to be issued.



APPENDICES.

APPENDIX AKEY PERSONNEL

G.Shilliday	Supervisor
R.Miles	Party Manager
J.Haigh	Administrator
T.O'Donnell	Quality Control Seismologists
S.Williams	
A.Stirling	Instrument Engineers
A.Bagley	
R.Cowan-Lunn	Instrument Engineers Trainees
J.Barret	
S.Martin	Airgun Mechanics
R.Campbell	
S.Simpson	
P.Hilton	Captain
C.McQuinn	Navigators-Geonav
E.Pickstone	
D.Hackenbruch	Survey Supervisor O.N.I.
J.McKenzie	Survey Operators O.N.I.
A.Yon Gallart	

APPENDIX BEQUIPMENTa) Recording

i) 3200 Metre Streamer (Plate 2)

Type Cable	: 48 live group, neutrally buoyant, universal gland streamer. 47 dead sections.
Length of Live Section	: 50 metres
Length of Dead Section	: 16.67 metres
Length of Depth Transducer Section	: 1.83 metres
Distance Group 1 to 48 (centres)	: 3142.48 metres
Group Interval	: 66.67 metres
Seismometer Type	: Pavey Acceleration Cancelling
Seismometer Interval	: Linear, 1.14 metres except centre two which are 8.33 metres apart.
Sensitivity	: 6.0 uV/uBar



ii) Recording Parameters

Amplifiers	: TI DFS III Binary Gain
Gain Mode	: Binary Gain
Record Length	: 5-11 seconds
Sample Rate	: 4 Milliseconds
Gain Constant	: 30 db.
Attack Rate	: 1500 db/sec.
Final Gain	: 120 db.
Trip	: As necessary
Initial Gain	: 30 - 42 db.
Upper Set Limit	: 62.5%
Lower Set Limit	: 25%
Filter -	
Low Cut	: 8Hz, 18 db/octave
High Cut	: 62Hz, 72 db/octave
Release Rate	: Fast 94 db/sec.
Delay time for RAW Monitors caused by displacement of RAW and record heads	: 26.7 milliseconds



iii) Data Channel Allocations - 3200 Metre Streamer

Function	Monitor Trace No.	System	Tape Channel
Timing	-	Both	0
Streamer Odd Groups 1-47	1-24	System I	1-24
Streamer Even Groups 2-48	31-54	System II	1-24
Waterbreak 1 (between groups 2L & 1D)	49	Both	31
Waterbreak 2 (between groups 11L & 10D)	48	Both	28
Waterbreak 3 (between groups 21L & 20D)	50	Both	29
Waterbreak 4 (between groups 31L & 30D)	49	Both	31
Waterbreak 5 (between groups 41L & 40D) or Sonobuoy data	50	Both	27
Waterbreak 6 (in front of group 48)	48	Both	28
Field Timebreak	4	System I	4
Field Timebreak	28	System II	8
DFS Synthetic Timebreak	8	System I	4
DFS Synthetic Timebreak	32	System II	8
Sonobuoy Tie In		Both	27
Sonobuoy Waterbreak		Both	29

B) Survey VesselM.V. "EUGENE MCDERMOTT II"

Flag	:	Bahamas
Homeport	:	Nassau
Trade	:	Foreign Going-Seismic Exploration
Owners	:	Worldwide Surveys Limited
Call Sign	:	ZQA-2012
Length	:	52.73 metres L.O.A.
Breadth	:	12.19 metres
Depth	:	4.27 metres
Draft	:	3.05 - 3.25 metres
Official Number	:	343728
Gross Tonnage	:	929.89 tonnes
Net Tonnage	:	249.09 tonnes
Engine Power	:	2 x 839.25 kW engines

APPENDIX COPERATION STATISTICS

Prospect	: Otway Basin -- H04
Operational period	: 16 Nov. - 1 Dec. 1974
Time spent on recording	: 154 hr. 14 min.
Time lost due to bad weather	: 95 hr. 50 min.
Time lost due to other reasons, (includes supplies, equipment and survey failures)	: Nil
Field tapes used	: 330 - (520576-520905)
Water depth range	: 18-3660 metres
Total production mileage	: 1369.19 km/850.96 miles
Production shotpoints	: 20,545
Autofires	: Nil



APPENDIX D

LIST OF FIELD TAPES AND SHOTPOINT NUMBERS

<u>Date Shot</u>	<u>Line Number</u>	<u>List of Shotpoints</u>	<u>Field Tape Numbers</u>		
			<u>Odd</u>	<u>Even</u>	
16.11.74	H04 - 57	1A - 68C		520576	
		1A - 107C	520577		
		69A - 125C		578	
		108A - 125C	579		
	H04 - 57A	126A - 178C		578	
		126A - 178C	579		
		179A - 216C		579	
		179A - 289C	580		
		217A - 328C		581	
		290A - 328C	582		
		329A - 400C		582	
		329A - 439C	583		
		401A - 511C		584	
		440A - 511C	585		
		512A - 556C		585	
		512A - 638C	586		
		557A - 638C		587	
		H04 - 87	1A - 61C		587
			1A - 61C	588	
			62A - 144C		588
62A - 205C	589				
145A - 233C			590		
206A - 233C	591				



<u>Date Shot</u>	<u>Line Number</u>	<u>List of Shotpoints</u>	<u>Field Tape Numbers</u>	
			<u>Odd</u>	<u>Even</u>
	H04 - 58	1A - 48C		520590
		1A - 48C	520591	
		49A - 111C		591
		49A - 192C	592	
		112A - 240C		593
		193A - 240C	594	
		241A - 263C		594
		241A - 263C	595	
	H04 - 103	1A - 50C		594
		1A - 101C	595	
		51A - 178C		596
		102A - 178C	597	
		179A - 227C		597
		179A - 296C	598	
		228A - 340C		599
		297A - 340C	600	
		341A - 403C		600
		341A - 450C	601	
		404A - 516A		602
		451A - 516A	603	
		516B - 558C		603
		516B - 624C	604	
		559A - 669C		605
		625A - 669C	606	
		670A - 730C		606
		670A - 730C	607	
	H04 - 38	1A - 48C	607	
17.11.74		1A - 119C		608
		49A - 114C	609	
		115A - 174C		609



<u>Date Shot</u>	<u>Line Number</u>	<u>List of Shotpoints</u>	<u>Field Tape Numbers</u>	
			<u>Odd</u>	<u>Even</u>
17.11.74	H04 - 38	115A - 290C	520610	
		175A - 251C		520611
		241A - 251C	612	
	H04 - 37A	1A - 54C		611
		1A - 54C	612	
		55A - 126C		612
		55A - 204C	613	
		127A - 276C		614
		205A - 276C	615	
		277A - 303C		615
		277A - 303C	616	
	H04 - 37	1A - 29C		615
		1A - 82C	616	
		30A - 138C		617
83A - 138C		618		
139A - 148C			618	
139A - 148C		619		
H04 - 36	1A - 42C		618	
	1A - 79A	619		
	43A - 79A		620	
H04 - 35	1A - 23C	619		
	1A - 87C		620	
	24A - 87C	621		
	88A - 138C		621	
	88A - 196C	622		
	139A - 225C		623	
	197A - 225C	624		



<u>Date Shot</u>	<u>Line Number</u>	<u>List of Shotpoints</u>	<u>Field Tape Numbers</u>	
			<u>Odd</u>	<u>Even</u>
17.11.74	H04 - 34	1A - 24C		520623
		1A - 24C	520624	
		25A - 84B		624
		25A - 156A	625	
		84C - 157C		626
		156B - 157C	627	
18.11.74	H04 - 76	1A - 72C		626
		1A - 72C	627	
		73A - 136C		627
		73A - 136C	628	
	H04 - 102	1A - 60C	628	
		1A - 126C		629
		61A - 126C	630	
		127A - 180C		630
		127A - 238C	631	
		181A - 288C		632
		239A - 288C	633	
		289A - 348C		633
		289A - 400C	634	
		349A - 467B		635
		401A - 467C	635	
468A - 500C		636		
468A - 500C	637			
H04 - 101	1A - 19C		636	
	1A - 84C	637		
	20A - 150C		638	
	85A - 150C	639		
	151A - 270C		639	



<u>Date Shot</u>	<u>Line Number</u>	<u>List of Shotpoints</u>	<u>Field Tape Numbers</u>	
			<u>Odd</u>	<u>Even</u>
18.11.74	H04 - 101	151A - 275C	520640	
		211A - 333A		520641
		276A - 332C	642	
		333B - 394C		642
		333A - 394C	643	
	H04 - 100	1A - 56C	643	
		1A - 124C		644
		57A - 124C	645	
		125A - 190C		645
		125A - 259C	646	
		191A - 259C		647
	H04 - 99	1A - 74C		647
		1A - 74C	648	
		75A - 136C		648
		75A - 184C	649	
		137A - 228C		650
		185A - 228C	651	
		229A - 271C		651
		229A - 313C	652	
		272A - 360C		653
314A - 360C		654		
361A - 397C		654		
361A - 397C	655			
19.11.74	H04 - 97	1A - 79C	655	
		1A - 134C		656
		80A - 134C	657	
		135A - 219C	658	
		135A - 183C		657



<u>Date Shot</u>	<u>Line Number</u>	<u>List of Shotpoints</u>	<u>Field Tape Numbers</u>	
			<u>Odd</u>	<u>Even</u>
19.11.74	H04 - 97	184A - 264C		520659
		220A - 264C	520660	
		265A - 343C	661	
		265A - 299C		660
		300A - 383C		662
		344A - 383C	663	
		384A - 385C		663
		384A - 385C	664	
	H04 - 98	1A - 69C		663
		1A - 141C	664	
		70A - 220C		665
		142A - 220C	666	
		221A - 266C		666
		221A - 266C	667	
H04 - 96	1A - 18C		666	
	1A - 99C	667		
	19A - 169C		668	
	100A - 169C	669		
	170A - 266C	670		
	170A - 246C		669	
	247A - 266C		671	
H04 - 47	1A - 123C		671	
	1A - 40C	670		
	41A - 123C	672		
	124A - 162C		672	
	124A - 248C	673		
	163A - 178C		674	
	179A - 248C		675	



<u>Date Shot</u>	<u>Line Number</u>	<u>List of Shotpoints</u>	<u>Field Tape Numbers</u>		
			<u>Odd</u>	<u>Even</u>	
19.11.74	H04 - 86	1A - 22C	520673		
		1A - 22C		520675	
		23A - 75C	675		
		23A - 169C		676	
		76A - 222C	677		
		170A - 224C		678	
		223A - 312C	678		
		223A - 372C		679	
		313A - 397C	680		
		373A - 397C		681	
		H04 - 40	1A - 58C	680	
			1A - 150C		682
			59A - 150C	683	
151A - 162C			683		
151A - 162C	684				
H04 - 41	1A - 36C		683		
	1A - 126C	684			
	37A - 126C		685		
20.11.74	H04 - 95	1A - 55C		685	
		1A - 55C	686		
		56A - 159C	687		
		56A - 144C		686	
		145A - 159C		688	
H04 - 43	1A - 3C	687			
	1A - 90C		688		
	4A - 90C	687			
	91A - 236C	690			
	91A - 149C		689		



<u>Date Shot</u>	<u>Line Number</u>	<u>List of Shotpoints</u>	<u>Field Tape Numbers</u>	
			<u>Odd</u>	<u>Even</u>
20.11.74	H04 - 43	237A - 300C		520691
		237A - 300C	520692	
		301A - 404C	693	
		301A - 382C		692
		383A - 404C		694
	H04 - 29	1A - 42C	693	
		1A - 116C		694
		43A - 126C	695	
		127A - 138C		695
		127A - 138C	696	
	H04 - 62	1A - 49C		695
		1A - 129C	696	
		50A - 129C		697
	H04 - 28	1A - 66C		697
		1A - 66C	698	
69A - 123C			698	
67A - 123C		699		
21.11.74	H04 - 52	1A - 22B		698
		1A - 84C	699	
		22C - 172C		700
		85A - 172C	701	
		173A - 229C		701
		173A - 253C	702	
		230A - 253C		703
	H04 - 83	1A - 60C	702	
	1A - 126C		703	
	61A - 126C	704		



<u>Date Shot</u>	<u>Line Number</u>	<u>List of Shotpoints</u>	<u>Field Tape Numbers</u>			
			<u>Odd</u>	<u>Even</u>		
21.11.74	H04 - 83	127A - 134C		520704		
		127A - 134C	520705			
21.11.74	H04 - 84A	1A - 70C		704		
		1A - 137C	705			
		71A - 218C		706		
		138A - 218C	707			
		219A - 235C		707		
		219A - 235C	708			
		21.11.74	H04 - 84B	1A - 42C		707
				1A - 130C	708	
				43A - 190C		709
				131A - 190C	710	
				191A - 276C		710
				191A - 336C	711	
				277A - 415C		712
				337A - 415C	713	
416A - 463C				713		
416A - 534C	714					
464A - 576C				715		
535A - 576C	716					
577A - 615C				716		
577A - 615C	717					
616A - 654B	716					
616A - 774B		718				
655A - 815B	719					
22.11.74		775A - 815B		720		
		816A - 900B	720			
		816A - 937B		721		
		901A - 1015B	722			



<u>Date Shot</u>	<u>Line Number</u>	<u>List of Shotpoints</u>	<u>Field Tape Numbers</u>			
			<u>Odd</u>	<u>Even</u>		
22.11.74	H04 - 84B	938A -1015B		520723		
		1016A -1049B	520723			
		1016A -1152B		724		
		1050A -1193B	725			
		1053A -1193B		726		
		1194A -1299B	726			
		1194A -1343B		727		
		1300A -1441A	728			
		1344A -1441A		729		
		1441B -1482B	729			
		1441B -1570B		730		
		1483A -1611B	731			
		1571A -1611B		732		
		1612A -1673B	732			
		1612A -1673B		733		
			H04 - 11	1A - 24B	732	
				1A - 76B		733
		25A - 191B	734			
		77A - 191B		735		
		192A - 252B	735			
		192A - 380B		736		
		253A - 408B	737			
		381A - 390B		738		
		391A - 408B		739		
	H04 - 12	1A - 21C	737			
		1A - 126C		739		
		22A - 126C	740			
		127A - 163C		740		
		127A - 255C	741			
		164A - 255C		742		



<u>Date Shot</u>	<u>Line Number</u>	<u>List of Shotpoints</u>	<u>Field Tape Numbers</u>	
			<u>Odd</u>	<u>Even</u>
22.11.74	H04 - 92	1A - 48C		520742
		1A - 48C	520743	
		49A - 61C		743
		49A - 168C	744	
		62A - 208C		745
		169A - 208C	746	
		209A - 220C		746
		209A - 320C	747	
	221A - 320C		748	
	H04 - 14	1A - 48C		748
		1A - 144C	749	
		49A - 144C		750
		145A - 176C	750	
		145A - 176C		751
H04 - 13	1A - 11C	750		
	1A - 108C		751	
	12A - 157C	752		
	109B - 157C		753	
	158A - 215C	753		
	158A - 215C		754	
H04 - 73	1A - 137C	753		
	1A - 83C		754	
	138A - 182C	755		
	84A - 182C		756	
	183A - 229C	756		
	183A - 330C		757	
	230A - 391C	758		
	331A - 391C		759	



<u>Date Shot</u>	<u>Line Number</u>	<u>List of Shotpoints</u>	<u>Field Tape Numbers</u>		
			<u>Odd</u>	<u>Even</u>	
23.11.74	H04 - 10	1A - 124C		520760	
		82A - 224C	520761		
		129A - 224C		762	
		225A - 268C	762		
		225A - 370C		763	
		269A - 415C	764		
		371A - 415C		765	
		416A - 514C	765		
		416A - 562C		766	
		515A - 666C	767		
		563A - 666C		768	
24.11.74	H04 - 93	1A - 36C	768		
		1A - 121C		769	
		37C - 161C	770		
		122A - 161C		771	
		162A - 246C	771		
		162A - 285C		772	
		247A - 372C	773		
		286A - 372C		774	
		373A - 411C	774		
		373A - 497C		775	
		412A - 536C	776		
		498A - 536C		777	
		537A - 591C	777		
		537A - 591C		778	
		H04 - 94	1A - 25C	777	
			1A - 69C		778
26A - 150C	779				
78A - 150C			780		
151A - 195C	780				



<u>Date Shot</u>	<u>Line Number</u>	<u>List of Shotpoints</u>	<u>Field Tape Numbers</u>		
			<u>Odd</u>	<u>Even</u>	
24.11.74	H04 - 94	151A - 276C		520781	
		196A - 318C	520782		
		277A - 318C		783	
		319A - 390C	783		
		319A - 431C		784	
		391A - 500C	785		
		432A - 500C		786	
		501A - 590C	786		
		501A - 609C		787	
		541A - 649C	788		
		610A - 649C		789	
		650A - 719C	789		
		650A - 759C		790	
		720A - 828C	791		
		760A - 828C		792	
		829A - 866C	792		
	829A - 937C		793		
	867A - 948C	794			
	938A - 948C		795		
		H04 - 50	1A - 30C	794	
			1A - 30C		796
			31A - 138C	796	
			31A - 174C		797
			139A - 282C	798	
			175A - 282C		799
			283A - 318C	799	
	283A - 428C			800	
	318C - 465C		801		
	429A - 465C			802	
	466A - 545C	802			
	466A - 545C		803		



<u>Date Shot</u>	<u>Line Number</u>	<u>List of Shotpoints</u>	<u>Field Tape Numbers</u>		
			<u>Odd</u>	<u>Even</u>	
24.11.74	H04 - 90	1A - 24C	520804		
		1A - 61C		520803	
		25A - 169B	804		
		62A - 169B		805	
		169C - 207C	805		
		169C - 207C		806	
25.11.74	H04 - 91	1A - 90C		806	
		1A - 120C	807		
		91A - 120C		808	
		121A - 214C	808		
		121A - 245C		809	
		215A - 337C	810		
		246A - 331C		811	
		338A - 372C	811		
		338A - 464C		812	
		374A - 504C	813		
		465A - 504C		814	
		505A - 558C	814		
		505A - 558C		815	
		H04 - 50A	546A - 589C	814	
			546A - 629C		815
590A - 725C	816				
630A - 725C			817		
726A - 777C	817				
726A - 838C			818		
778A - 838C	819				
H04 - 89	1A - 26C		818		
	1A - 70C	819			
	27A - 70C		820		



<u>Date Shot</u>	<u>Line Number</u>	<u>List of Shotpoints</u>	<u>Field Tape Numbers</u>	
			<u>Odd</u>	<u>Even</u>
25.11.74	H04 - 89	71A - 148C	520820	
		71A - 193C		520821
		149A - 270C	822	
		194A - 270C		823
		271A - 318C	823	
		271A - 396C		824
		319A - 444C	825	
		397A - 444C		826
		445A - 522C	826	
		445A - 570C		827
		523A - 646C	828	
		571A - 646C		829
		647A - 688C	829	
		647A - 756C		830
		689A - 798C	831	
		757A - 798C		832
		799A - 865C	832	
		799A - 911B		833
		866A - 972C	834	
		912A - 972C		835
973A - 984C	835			
973A - 984C		836		
	H04 - 88	1A - 46C	835	
		1A - 124C		836
		47A - 192C	837	
26.11.74		125A - 192C		838
		193A - 270C	838	
		193A - 270C		839
		271A - 271C		838
		272A - 342C		839



<u>Date Shot</u>	<u>Line Number</u>	<u>List of Shotpoints</u>	<u>Field Tape Numbers</u>			
			<u>Odd</u>	<u>Even</u>		
26.11.74	H04 - 88	271A - 419C	520840			
		343A - 419C		520841		
		420A - 490C	841			
		420A - 566C		842		
		491A - 638C	843			
		567A - 638C		844		
		639A - 711C	844			
		639A - 772C		845		
		712A - 772C	846			
30.11.74	H04 - 65	1A - 70C	846			
		1A - 137C		847		
		71A - 137C	848			
		138A - 217C		848		
		138A - 283C	849			
		218A - 364C		850		
		284A - 364C	851			
		365A - 429C		851		
		365A - 510C	852			
		430A - 576C		853		
		511A - 576C	854			
		577A - 654C		854		
		577A - 712C	855			
		655A - 712C		856		
					856	
			H04 - 82	1A - 84C		856
				1A - 11C	857	
		12A - 158C	858			
		85A - 158C		859		
		159A - 230C	859			
		159A - 290C		860		
		231A - 340C	861			
		291A - 340C		862		



<u>Date Shot</u>	<u>Line Number</u>	<u>List of Shotpoints</u>	<u>Field Tape Numbers</u>	
			<u>Odd</u>	<u>Even</u>
30.11.74	H04 - 82	341A - 386C	520862	
		341A - 438C		520863
		387A - 482C	864	
		439A - 442B		865
		442C - 539C		866
		483A - 539C	867	
		540A - 578C		867
		540A - 669C	868	
		579A - 708C		869
		669A - 708C	870	
		709A - 738C		870
		709A - 840C	871	
		739A - 864C		872
		841A - 864C	873	
		865A - 868C		873
		865A - 912C	874	
869A - 912C		875		
1.12.74	H04 - 81	1A - 59C	874	
		1A - 89C		875
		60A - 89C	876	
		90A - 181C		876
		90A - 238C	877	
		182A - 326C		878
		239A - 326C	879	
		327A - 386C		879
		327A - 472C	880	
		387A - 531C		881
		473A - 531C	882	
		532A - 617C		882
		532A - 666C	883	
		618A - 666C		884



<u>Date Shot</u>	<u>Line Number</u>	<u>List of Shotpoints</u>	<u>Field Tape Numbers</u>	
			<u>Odd</u>	<u>Even</u>
1.12.74	H04 - 06	1A - 92C		520884
		1A - 92C	520885	
		93A - 144C		885
		93A - 239C	886	
		145A - 281C		887
		240A - 281C	888	
	H04 - 08	1A - 100C		888
		1A - 144C	889	
		101A - 218C		890
		145A - 218C	891	
	H04 - 80	1A - 28C		890
		1A - 28C	891	
		29A - 68C		891
		29A - 174C	892	
		69A - 210C		893
		175A - 210C	894	
		211A - 318C		894
		211A - 360C	895	
		319A - 456C		896
		361A - 456C	897	
		457A - 507C		897
	457A - 556C	898		
	508A - 556C		899	
	H04 - 03	1A - 47C	898	
		1A - 93C		899
		48A - 93C	900	
		94A - 104C		900
94A - 204C		901		
105A - 252C			902	
205A - 252C		903		



<u>Date Shot</u>	<u>Line Number</u>	<u>List of Shotpoints</u>	<u>Field Tape Numbers</u>	
			<u>Odd</u>	<u>Even</u>
1.12.74	H04 - 03	253A - 350B		520903
		253A - 364C	520904	
		350C - 364C		905

OTWAY/KING PART-IX*

VOL 3/3

FINAL REPORT
OFFSHORE NAVIGATION, INC.
PROJECT 659

GEOPHYSICAL SERVICE INTERNATIONAL
PARTY 931

FOR

HEMATITE PETROLEUM PTY. LTD.

OTWAY BASIN, VICTORIA, AUSTRALIA
HO-4 SEISMIC PROGRAM

NOVEMBER - DECEMBER 1974

A B S T R A C T

Project 659 was a Shoran positioned and controlled marine seismic survey for potential petroleum deposits in the Otway Basin, offshore, south of Victoria, Australia.

The principal was The Broken Hill Proprietary Co. Ltd., Oil and Gas Division (HEMATITE Petroleum Pty. Ltd.).

Geophysical Service International (GSI) was the prime contractor and operator.

Offshore Navigation, Inc. (ONI) employed a Shoran radiolocation system to provide horizontal control for the survey.

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FIGURES

1. Simplified Block diagram of Basic Radio Equipment of a Shoran System
2. Area of uncertainty of position due to error in range measurement
3. Position ambiguity in Circular Range System
4. XR Shoran Accuracy Test

5. Relative area of coverage Circular Ranging System

I. THE SHORAN RADIOPOSITIONING SYSTEM

The Shoran system is a radar transponder type of radio-positioning system. The Shoran mobile station equipment measures the distance from its location to those of two fixed ground beacon stations. The position of the mobile unit is thus fixed at the intersection of the two circular distance or range arcs so determined. The position of the ground beacon stations or base stations is normally accurately known, so that the corresponding position of the mobile station can be accurately computed or determined by graphical methods. Should the position coordinates of the base stations not be accurately known, the mobile station may still be positioned relative to the baseline determined by the base station locations.

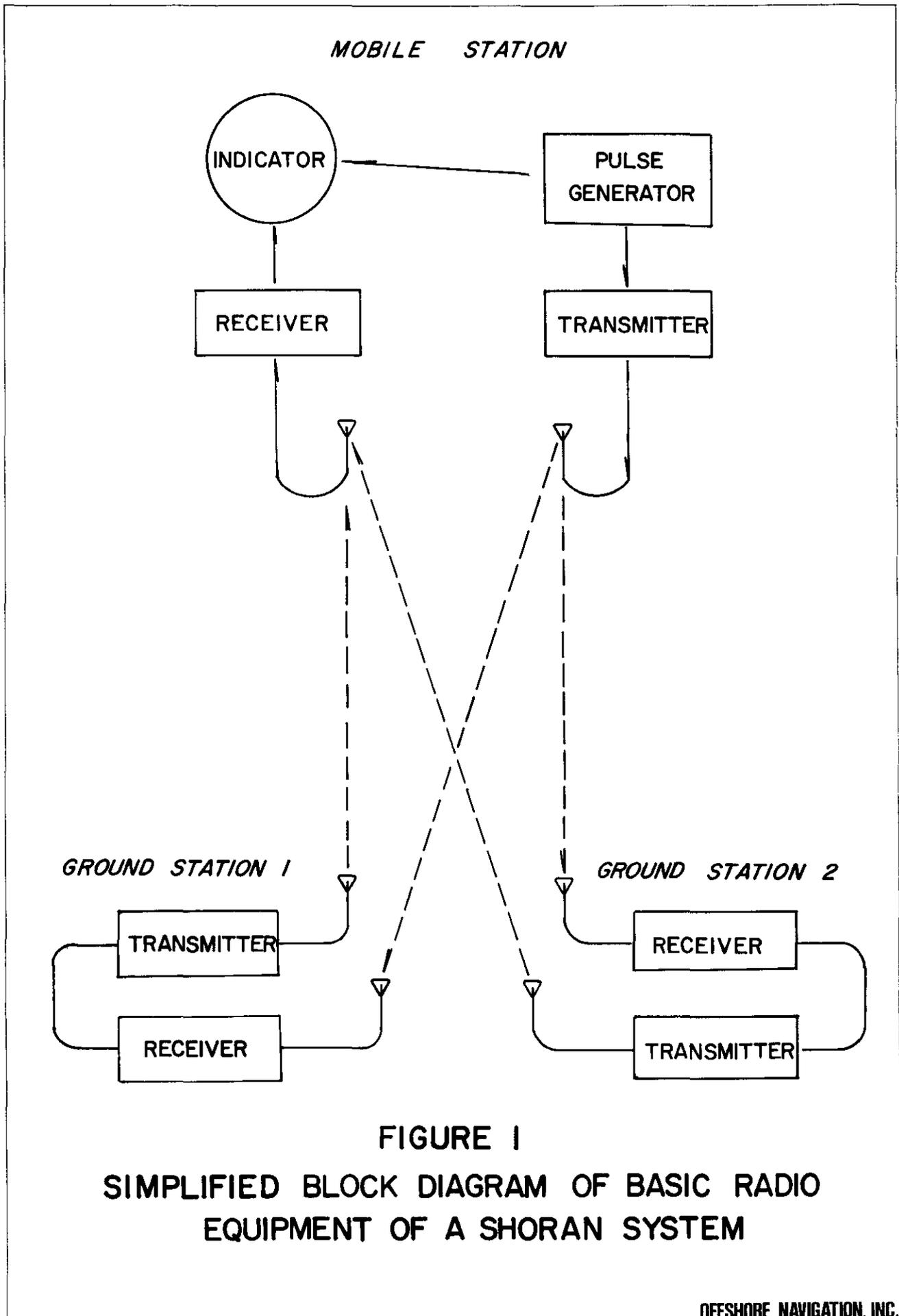
The Shoran mobile unit measures the distance of the two base stations by measuring the time required for pulses of radio signals to travel from the mobile station to each base station and return. The time intervals so measured are related to the corresponding distances by using the highly constant velocity characteristic of radio waves in air through the simple relationship:

Total distance covered = Elapsed time x velocity.

I. THE SHORAN RADIOPOSITIONING SYSTEM (continued)

Because of this relationship, it is possible to graduate the indicating dials in the mobile unit in terms of distance rather than elapsed time. For example, using radio waves which have a velocity of approximately 186,000 miles per second, the scale of the time-interval measuring system is graduated so that when the time interval required for a round trip of the signal is 1/1000 second, the scale reads 93 miles. (The total distance traveled by the radio signals in 1/1000 second is 186 miles. Since this is round trip distance, it must be halved to obtain the distance between mobile and base stations.) The Shoran dials are graduated in terms of statute miles rather than nautical miles.

The basic equipment units used to create the round trip signals paths originating and terminating at the mobile station are shown in Figure 1. This equipment consists of a signal source (labeled pulse generator in Figure 1), a transmitter, receiver and indicator unit comprising the mobile station, and a receiver coupled to a transmitter at each base station.



I. THE SHORAN RADIOPOSITIONING SYSTEM (continued)

Pulse signals originating at the mobile station are radiated from the mobile transmitter and received by one of the base stations. At this base station, the pulse is sent from the output of the receiver to the input of the transmitter, and is then retransmitted back to the mobile station. After passing through the mobile receiver, the pulse is routed to an indicating circuit where its time lag, or lapse, with respect to the original outgoing pulse is determined, and indicated in terms of distance rather than units of time.

Other pulses are transmitted to the second base station, using a different radio frequency to permit their discrimination from those intended for the first base station. These pulses are received and retransmitted by the second base station, and on their return to the mobile station are similarly sent through the indicating circuits for measurement of the time required for their round trip and the indication of corresponding distance. Thus, the equipment provides continuous, essentially simultaneous, indications of the distances to both base stations.

The Shoran system operates in the VHF/UHF portion of the

I. THE SHORAN RADIOPOSITIONING SYSTEM (continued)

radio spectrum. Normally, three separate frequencies are used. Two of these are transmitted alternately by the mobile station to interrogate each base station in turn, as previously described. The third frequency is utilized by the base stations to retransmit the received pulses back to the mobile station. Both base stations transmit on the single frequency in order to utilize a single receiver at the mobile station.

The propagation characteristics of VHF/UHF radio signals is such that they tend to travel in straight lines. While they are refracted in the atmosphere to some small extent, they do not tend to follow the earth's curvature as do radio signals of considerable lower frequency. They lack the ability to "see" beyond the radio horizon. Thus the Shoran system is essentially a "line of sight" system, with the maximum range being limited, to a large extent, by the heights of the mobile and base station antennas.

The range of the system under particular conditions may be estimated from the relationship

$$d = k (\sqrt{h_1} + \sqrt{h_2})$$

I. THE SHORAN RADIOPOSITIONING SYSTEM (continued)

where,

- d = estimated maximum range, in miles
- h_1 = height of mobile station antenna, in feet, above sea level
- h_2 = height of base station antenna, in feet, above sea level
- k = empirical range factor

The factor, k, depends upon several factors among which are included antenna gain, receiver sensitivity, transmitter power and atmospheric refractive index. It will vary in value from 1.5 to 2.5, under normally encountered conditions.

The range formula presumes no obstructions between mobile and base stations. The presence of intervening hills or other obstructions can reduce the otherwise obtainable range.

Under certain conditions, abnormally long Shoran ranges can be obtained by exploiting the existence of an atmospheric phenomenon known as a temperature inversion layer. This is a layer of high refractive index occurring with the first few thousand feet of the atmosphere. It has the effect of confining the radio waves near the earth's

I. THE SHORAN RADIOPOSITIONING SYSTEM (continued)

surface, and acts as a duct to bend radio waves around the curvature of the earth. Under these conditions the factor, k , may be several times greater than normal. In some marine areas of the world, this phenomenon occurs quite regularly during certain seasons.

The instrumental accuracy of the Shoran equipment, when properly calibrated, is 50-75 feet on a single range. The overall position accuracy is related to the range accuracy by the angle of intersection, at the mobile station, between the two Shoran range circles. This is illustrated in Figure 2. In normal geophysical operations, this angle of intersection is held between 30 and 150 degrees. Refer to Appendix A for examples of areas of coverage for different angles of intersection of the Shoran range circles.

The range accuracy of the Shoran system can be improved, possibly by a factor of 2, by correcting the propagation velocity slightly under varying meteorological conditions, and by the application of more rigid calibration and operating specifications. For most operations, this

I. THE SHORAN RADIOPOSITIONING SYSTEM (continued)

additional accuracy cannot be economically justified.

In computing (or determining graphically) the position from a pair of Shoran ranges, cognizance must be maintained that a position ambiguity may exist. Each pair of ranges (one to each base station) actually determines two independent positions, one on each side of the Shoran baseline, as illustrated in Figure 3. One position is the "mirror image," so to speak, of the other. Further, the Shoran mileage dials repeat every 100 miles of range. To eliminate this ambiguity one must know, from other means, the correct side of the baseline and the distance to each base station within the proper multiple of 100 miles.

II. EXTENDED RANGE (XR) SHORAN

In 1968, certain experiments with the Shoran System resulted in the acquisition of hardware components to improve the overall signal to noise ratio of the System and to appreciably extend the range over which the Shoran

II. EXTENDED RANGE (XR) SHORAN (continued)

System can be effectively used. Briefly, the system additions consist of a new receiver, preamplifier, pulse modulation and demodulation circuitry, receiver modifications and improved antenna hardware and transmission lines.

In most cases, these additions and modifications can be added to existing systems in the field. However, experience has indicated that the best results are obtained when the complete system with XR hardware is mobilized as a unit.

Field tests conducted in the Gulf of Mexico indicated that ranges of 150 miles or more could be reasonably expected 24 hours per day. At night, ranges in excess of 200 miles were obtained. Where accuracy checks could be made, no appreciable decrease in system accuracy was observed. The Gulf of Mexico tests were conducted with base station antenna heights of 50 to 100 feet and with the vessel antenna height of 50 to 60 feet above the water. No experimental tests have been conducted from elevated base station sites.

II. EXTENDED RANGE (XR) SHORAN (continued)

Reports from field operations tend to bear out the results of the Gulf of Mexico tests; that is, ranges of 150 miles reasonably available, with 200 - 250 mile ranges obtainable under certain conditions. Tropical areas are more favorable for Shoran propagation and ranges in northern latitudes are limited to 100 - 150 miles.

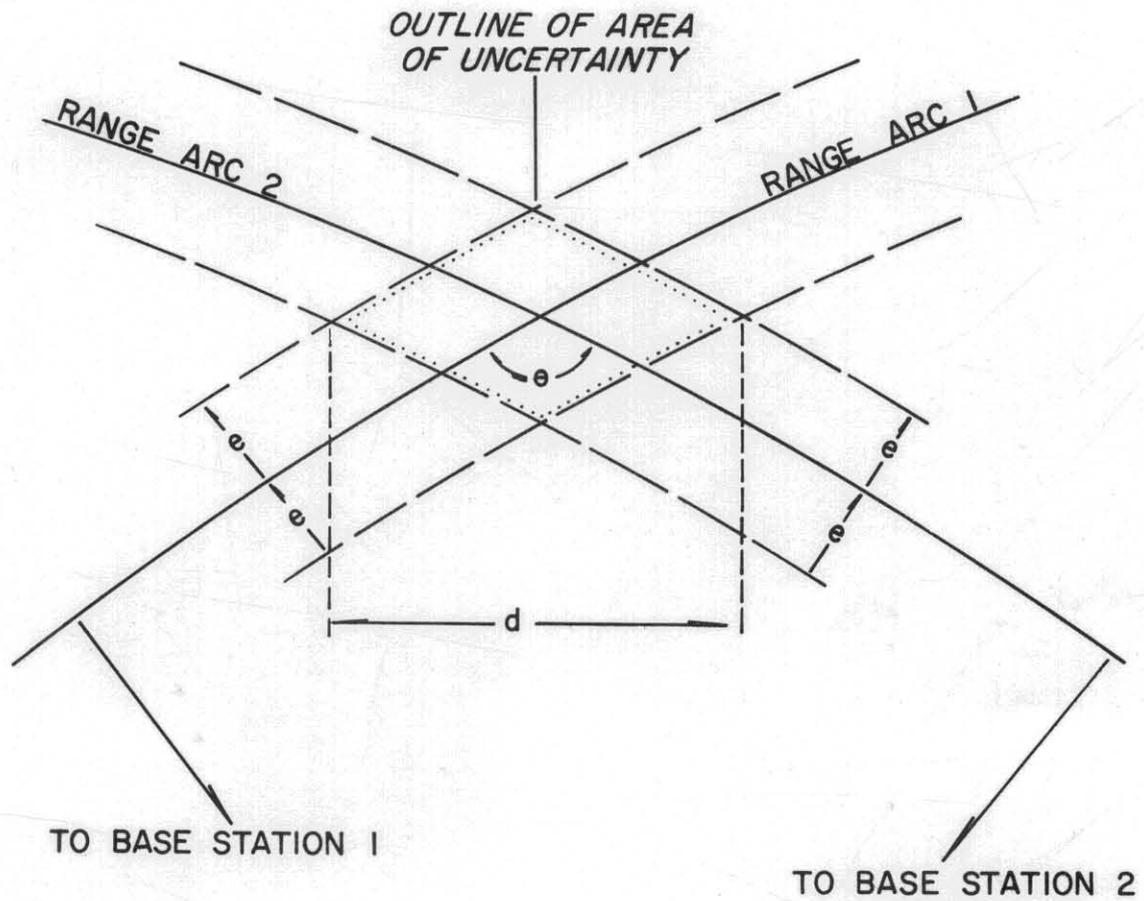
III. RESULTS OF RANGE ACCURACY TESTS

During the month of April 1969, measurements were taken along the coast of the Gulf of Mexico to further define the accuracy with which extended ranges could be measured with the Shoran equipment. The results of those measurements are shown in Figure 4. Measurements were taken between a mobile station located at points along the Mississippi, Alabama, and Florida coasts and three base stations positions located on the coast of Louisiana and Mississippi. All points occupied were either geodetic positions or were tied by land survey to nearby geodetic positions.

III. RESULTS OF RANGE ACCURACY TESTS (continued)

Each vertical bar on the graph represents a particular range that was read. The length of the bar indicates the range of errors determined (that is, measured distance minus the computed distance) for a series of measurements taken with different equipments under varying weather conditions.

Prior to the start of these tests and subsequent to their termination, the calibration of the Shoran equipment was checked at a range of approximately 28 miles. The measurements made over the calibration range are not included in the test data.



$$d = \frac{2e}{\sin \frac{\theta}{2}} \text{ where}$$

e = RANGE ERROR

θ = INTERSECTION ANGLE OF RANGE CIRCLES

5 cm

FIGURE 2

AREA OF UNCERTAINTY OF POSITION
DUE TO ERROR IN RANGE MEASUREMENT

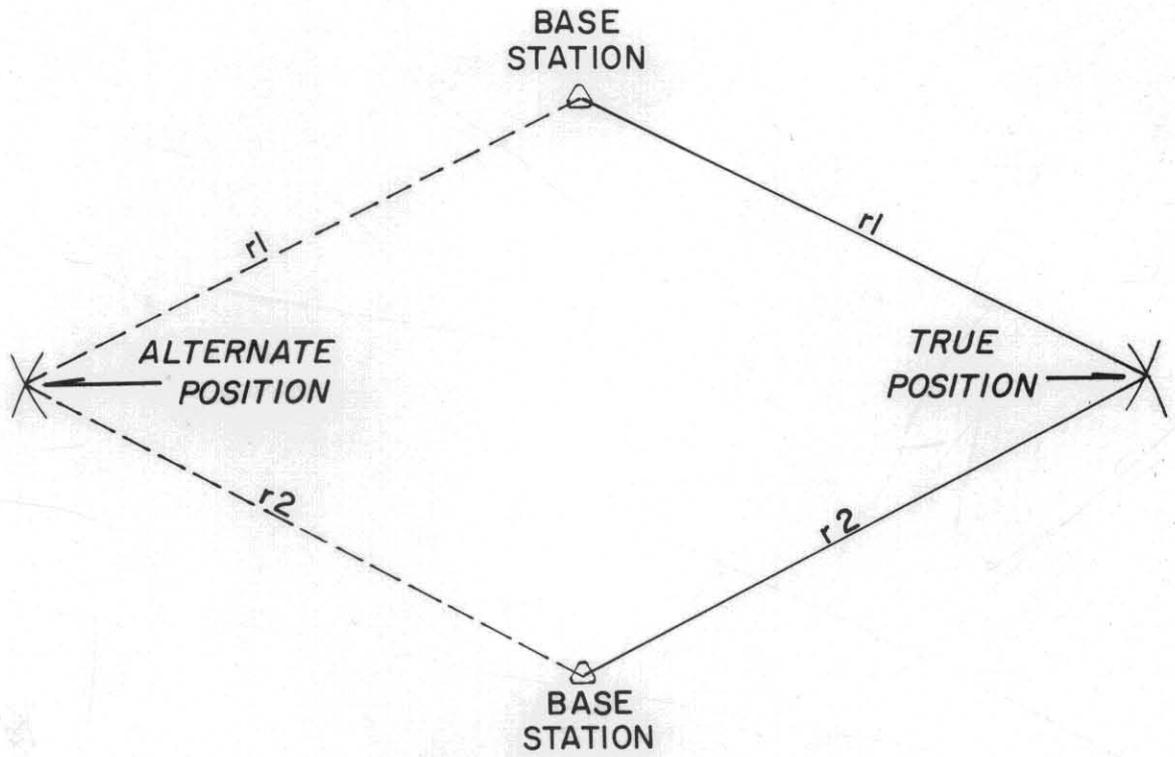


FIGURE 3

POSITION AMBIGUITY IN CIRCULAR RANGE SYSTEM

FIGURE 4

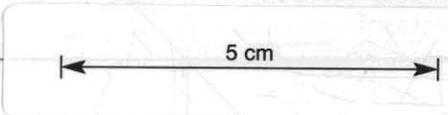
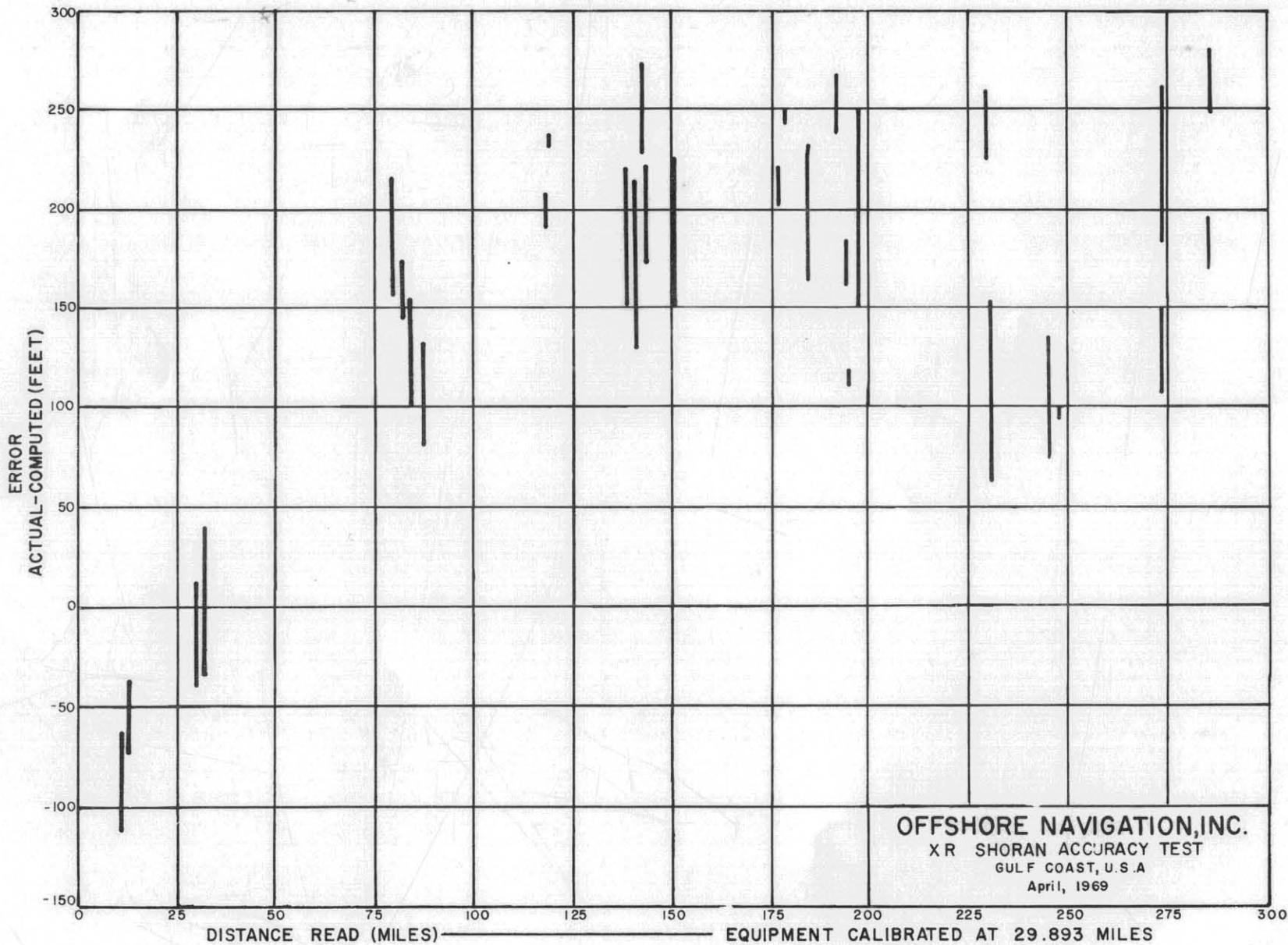
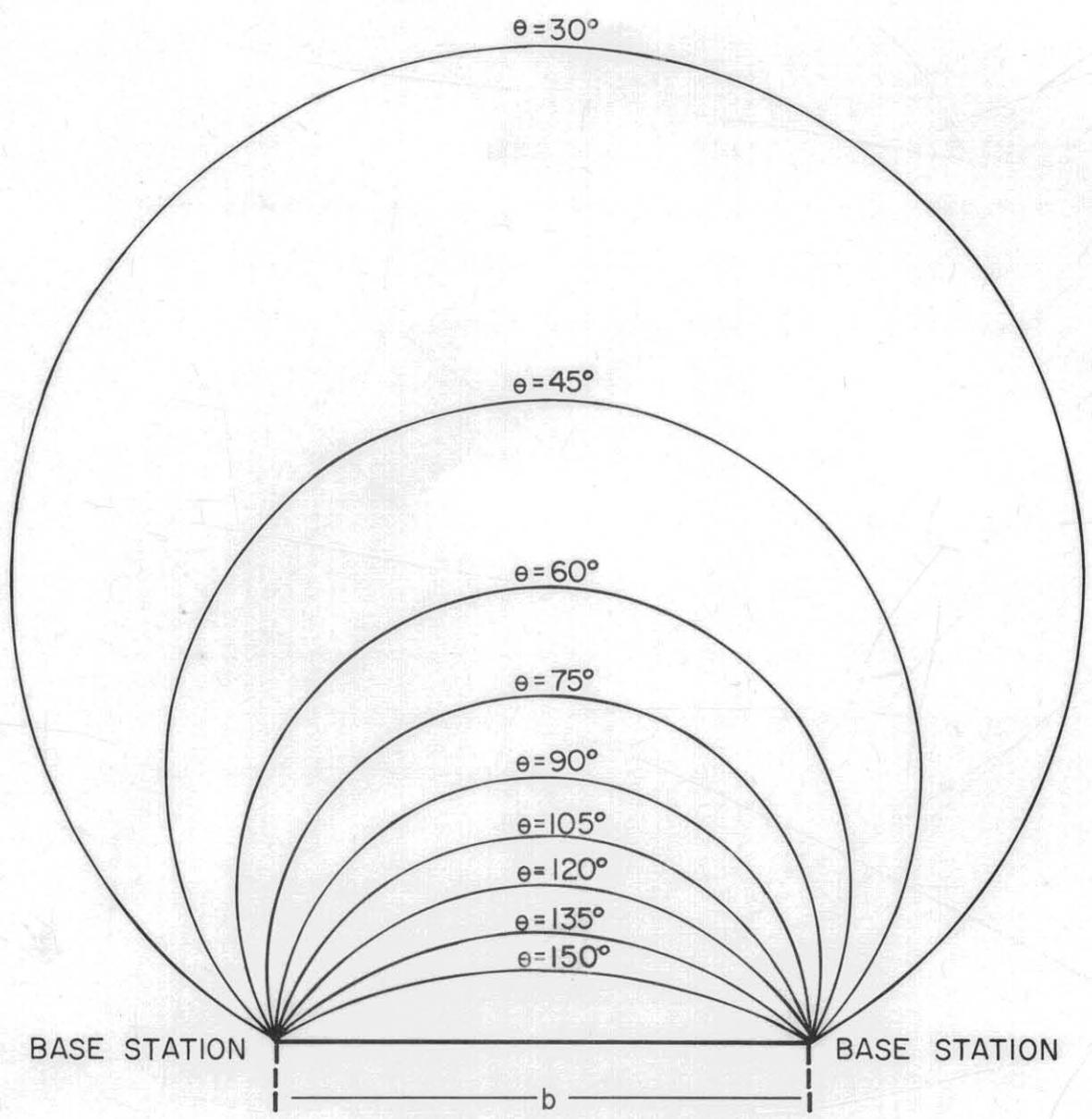


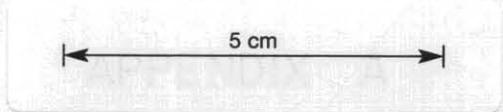
Figure 5



ALL ARCS ARE PORTIONS OF CIRCLES THROUGH BASE STATION POSITIONS OF RADIUS GIVEN BY

$$r = \frac{b}{2 \sin \theta}$$

WHERE θ IS ANGLE OF INTERSECTION BETWEEN RANGE CIRCLES



**RELATIVE AREA OF COVERAGE
CIRCULAR RANGING SYSTEM**

IV. AREA OF OPERATIONS

Operations were conducted in the Otway Basin off the coast of Victoria, Australia. The work area extended along the coast from west of Portland to King Island, running about 50 miles offshore with one line extending to 95 miles offshore. The prospect was designated by HEMATITE as:

OTWAY BASIN, HO-4 SEISMIC PROGRAM

The ONI base of operation for this survey was established in Portland, Victoria 12 November 1974. From this base of operation, radiocommunications were maintained with all Shoran installations.

V. FIELD OPERATIONS RECAP

11 November 1974 -

Prospect in the Bight area completed this date. Shoran base stations dismantled and underway via road transport to Portland.

12 November 1974 -

0800 hours - The recording vessel, M/V EUGENE MCDERMOTT II arrived in Port Lincoln and was met by the ONI party chief. The ONI party chief and mobile operator removed the Shoran mobile indicating equipment

V. FIELD OPERATIONS RECAP (continued)

from the vessel. The party chief and second mobile operator travelled by road to Portland with the Shoran mobile indicating equipment. The ONI first mobile operator travelled via commercial flight to Mt. Gambier, was picked up and taken by road to Portland. The ONI area supervisor and mobile trainee travelled by air from Perth to Portland.

13 November 1974 -

Two camphelpers and one complete Shoran base station arrived at Portland with landrover and trailer this date. The truck with the three base operators and other Shoran base stations had broken down enroute. Alternate arrangements were made to get personnel and equipment to Portland.

14 November 1974 -

The ONI base operators arrived via charter flight in the morning and the remaining Shoran base station equipment arrived in Portland in the afternoon via hired truck. Station Mt. Richmond was set in the evening and began installation of the Shoran base station equipment at Station Mt. Warrnambool.

1800 hours - The M/V EUGENE MCDERMOTT II arrived in Portland.

ONI area supervisor and mobile operators completely checked out the Shoran dual antenna system on board the recording vessel.

15 November 1974 -

0730 hours - Station Mt. Warrnambool installed and operational.

V. FIELD OPERATIONS RECAP (continued)

0730 - 1000 hours - Operational difficulties with Shoran base station equipment at Station Mt. Warrnambool and coax difficulties experienced at Station Mt. Richmond.

1000 - 1400 hours - Shoran system operational with base station equipment at Station Mt. Warrnambool and mobile indicating equipment at Station Mt. Richmond. Calibrated all Shoran base station equipment against both sets of Shoran mobile indicating equipment.

On completion of this Shoran calibration, the Shoran mobile indicating equipment and mobile operators were returned to Portland. The Shoran mobile indicating equipment was re-installed on board the M/V EUGENE MCDERMOTT II this date. Shoran base station equipment was transported to Stations Mt. Richmond and Crowes and installed.

1500 hours - The M/V EUGENE MCDERMOTT II departed Portland.

2030 hours - Shoran Station Crowes installed and operational.

After observing Shoran Three-Way Fixes, laying of the seismic cable began.

16 - 25 November 1974 -

Geophysical operations began at 0003 hours 16 November 1974 (Line H04-57, S.P. 1).

Production went very good during this time period with some difficulties experienced with the transmitter at Station Crowes and difficulties with the coax at Station Mt. Richmond. All difficulties were repaired by the ONI party chief with no loss time.

V. FIELD OPERATIONS RECAP (continued)

26 November 1974 -

1200 hours - Geophysical operations discontinued due to high swells causing a noisy cable.

30 November 1974 -

0825 hours - Resumed geophysical operations (Line H0-4-65, S.P. 1).

1 December 1974 -

2320 hours - Completed geophysical operations (Line H04-3, S.P. 364). Began picking up cable.

2 December 1974 -

0110 hours - Cable on board. Underway to Davenport, Tasmania. Shoran stations secured and instructed to begin dismantling.

The Shoran base stations were dismantled 2 December 1974 and transported via road to Gippsland, Victoria for the next prospect area.

3 December 1974 -

Shoran base station equipment installed for the next prospect. M/V EUGENE MCDERMOTT II arrived at Davenport.

VI. GENERAL INFORMATION

A. Shoran frequencies used were:

Mobile Transmitter 230/250 MHz

Base Transmitter 300 MHz

B. Satisfactory radiotelephone communications between all Shoran installations were maintained on the frequency of 4637.5 (SSB) kilocycles.

C. The Shoran field data was turned over to GSI representatives at the conclusion of operations.

D. Three Shoran base station installations were provided by ONI for this survey.

E. Three Shoran base station sites were occupied during this operation. They were:

STATION CROWES

STATION MOUNT RICHMOND

STATION MOUNT WARRNAMBOOL

F. Maximum Shoran range observed during the survey was 150 miles.

VI. GENERAL INFORMATION (continued)

- G. Shoran Range Extension (XR) equipment was provided by ONI for this survey.
- H. Shoran base station equipment was checked for proper calibration prior to the commencement of operations by means of a direct measurement between Shoran Stations Mount Richmond and Mount Warrnambool.
- I. The Shoran mobile indicating unit was checked on every seismic line surveyed during the operation for proper zero set. The equipment was zero checked at a setting of 99.808 (short path, Gate on) miles.
- J. ONI provided the following peripheral equipment for this survey:
- Pulse Follower
 - Digital Printer
 - Digital Track Plotter
 - Dual Antenna System
- K. No loss time was experienced during this operation due to Shoran equipment malfunction.

VII. MAPPING

Machine computed preplots, indicating the Shoran and grid coordinates of each shotpoint location to be occupied during this survey, were provided to the field operations by GSI. The interval between shotpoint locations was constant at 66.67 meters.

No final mapping of this survey was accomplished by ONI. All Shoran field data was turned over to the GSI representative at the conclusion of the survey.

For the purpose of preplotting of the survey program, the Universal Transverse Mercator Projection, Australian National Spheroid of Reference, Zone 54, Central Meridian 141° East, AUSTRALIAN GEODETIC DATUM were used.

VIII. SHORAN THREE-WAY FIXES

The following pages contain scale factor recomputes of "Running Shoran Three-Way Fixes" observed during this survey period. The third range of these fixes was interpolated using time as argument. These interpolated ranges are indicated by a check mark.

082155

SCALE FACTORED

STATIONS	RANGES	POSITION	TIE
	NOV 15-2105		
MT. RICHMOND	47.298	X= 559507.	5.
MT. WARRNAVBOOR	70.950	Y= 5691735.	
CROWES	91.299 ✓		
	NOV 15-2106		
MT. RICHMOND	47.308	X= 559487.	4.
MT. WARRNAVBOOR	70.970	Y= 5691710.	
CROWES	91.313 ✓		
	NOV 15-2107		
MT. RICHMOND	47.324	X= 559464.	7.
MT. WARRNAVBOOR	70.991 ✓	Y= 5691079.	
CROWES	91.332		
	NOV 15-2108		
MT. RICHMOND	47.334	X= 559440.	2.
MT. WARRNAVBOOR	71.013 ✓	Y= 5691051.	
CROWES	91.342		
	NOV 15-2109		
MT. RICHMOND	47.348	X= 559425.	1.
MT. WARRNAVBOOR	71.034	Y= 5691021.	
CROWES	91.356 ✓		

082156

SCALE FACTORED

STATIONS	RANGES	POSITION	TIE
	NOV 15-2110		
MT. RICHMOND	47.360	X= 559408.	3.
MT. WARRNAVBOOR	71.052	Y= 5691590.	
CROWES	91.371 ✓		
	NOV 15-2111		
MT. RICHMOND	47.373	X= 559388.	0.
MT. WARRNAVBOOR	71.075 ✓	Y= 5691565.	
CROWES	91.385		
	NOV 15-2112		
MT. RICHMOND	47.386	X= 559369.	3.
MT. WARRNAVBOOR	71.098 ✓	Y= 5691534.	
CROWES	91.398		
	NOV 15-2113		
MT. RICHMOND	47.396	X= 559348.	7.
MT. WARRNAVBOOR	71.121	Y= 5691507.	
CROWES	91.411 ✓		
	NOV 15-2114		
MT. RICHMOND	47.406	X= 559332.	6.
MT. WARRNAVBOOR	71.136	Y= 5691480.	
CROWES	91.423 ✓		

082157

SCALE FACTORED

STATIONS	RANGES	POSITION	TIE
	NOV 15-2115		
MT. RICHMOND	47.418	X= 559314.	7.
MT. WARRNAVBOOR	71.155 ✓	Y= 5691459.	
CROWES	91.436		
	NOV 15-2116		
MT. RICHMOND	47.433	X= 559290.	4.
MT. WARRNAVBOOR	71.173 ✓	Y= 5691431.	
CROWES	91.452		
	NOV 15-2117		
MT. RICHMOND	47.446	X= 559277.	4.
MT. WARRNAVBOOR	71.192	Y= 5691403.	
CROWES	91.466 ✓		
	NOV 15-2118		
MT. RICHMOND	47.457	X= 559258.	3.
MT. WARRNAVBOOR	71.210	Y= 5691380.	
CROWES	91.481 ✓		
	NOV 15-2119		
MT. RICHMOND	47.469	X= 559239.	3.
MT. WARRNAVBOOR	71.229 ✓	Y= 5691354.	
CROWES	91.495		

082158

SCALE FACTORED

STATIONS	RANGES	POSITION	TIE
		NOV 15-2120	
MT. RICHMOND	47.482	X= 559220.	6.
MT. WARRNAVBOOR	71.248 ✓	Y= 5691320.	
CROWES	91.504		
		NOV 21-1	
MT. RICHMOND	72.897	X= 641742.	2.
MT. WARRNAVBOOR	29.326	Y= 5712594.	
CROWES	39.136 ✓		
		NOV 21-2	
MT. RICHMOND	72.899	X= 641770.	10.
MT. WARRNAVBOOR	29.268	Y= 5712074.	
CROWES	39.118 ✓		
		NOV 21-3	
MT. RICHMOND	72.897	X= 641817.	24.
MT. WARRNAVBOOR	29.176 ✓	Y= 5712798.	
CROWES	39.100		
		NOV 21-4	
MT. RICHMOND	72.899	X= 641861.	42.
MT. WARRNAVBOOR	29.087 ✓	Y= 5712921.	
CROWES	39.082		

082159

SCALE FACTORED

STATIONS	RANGES	POSITION	TIE
NOV 21-5			
MT. RICHMOND	72.909	X= 641930.	50.
MT. WARRNAVBOOR	28.997	Y= 5713045.	
CROWES	39.043 ✓		
NOV 21-6			
MT. RICHMOND	72.913	X= 641985.	43.
MT. WARRNAVBOOR	28.945	Y= 5713120.	
CROWES	39.004 ✓		
NOV 21-7			
MT. RICHMOND	72.919	X= 642041.	37.
MT. WARRNAVBOOR	28.892 ✓	Y= 5713207.	
CROWES	38.965		
NOV 21-8			
MT. RICHMOND	72.924	X= 642083.	40.
MT. WARRNAVBOOR	28.840 ✓	Y= 5713281.	
CROWES	38.940		
NOV 21-9			
MT. RICHMOND	72.928	X= 642131.	37.
MT. WARRNAVBOOR	28.787	Y= 5713360.	
CROWES	38.908 ✓		

082160

SCALE FACTORED

STATIONS	RANGES	POSITION	TIE
	NOV 21-10		
MT. RICHMOND	72.928	X= 642170.	34.
MT. WARRNAVBOOK	28.730	Y= 5713440.	
CROWES	38.877 ✓		
	NOV 21-11		
MT. RICHMOND	72.934	X= 642220.	33.
MT. WARRNAVBOOK	28.676 ✓	Y= 5713520.	
CROWES	38.846		
	NOV 21-12		
MT. RICHMOND	72.939	X= 642260.	37.
MT. WARRNAVBOOK	28.620 ✓	Y= 5713600.	
CROWES	38.821		
	NOV 21-13		
MT. RICHMOND	72.944	X= 642310.	36.
MT. WARRNAVBOOK	28.565	Y= 5713087.	
CROWES	38.789 ✓		
	NOV 21-14		
MT. RICHMOND	72.949	X= 642360.	33.
MT. WARRNAVBOOK	28.514	Y= 5713763.	
CROWES	38.757 ✓		

082161

SCALE FACTORED

STATIONS	RANGES	POSITION	TIE
NOV 23-1			
MT. RICHMOND	101.867	X= 685087.	20.
MT. WARRNAVBORR	44.447 ✓	Y= 5695225.	
CROWES	16.910		
NOV 23-2			
MT. RICHMOND	101.936 ✓	X= 685125.	23.
MT. WARRNAVBORR	44.553	Y= 5695050.	
CROWES	16.970		
NOV 23-3			
MT. RICHMOND	102.005	X= 685155.	29.
MT. WARRNAVBORR	44.659 ✓	Y= 5694860.	
CROWES	17.040		
NOV 23-4			
MT. RICHMOND	102.066 ✓	X= 685187.	25.
MT. WARRNAVBORR	44.765	Y= 5694694.	
CROWES	17.099		
NOV 23-5			
MT. RICHMOND	102.126	X= 685220.	21.
MT. WARRNAVBORR	44.869 ✓	Y= 5694520.	
CROWES	17.155		

082162

SCALE FACTORED

STATIONS	RANGES	POSITION	TIE
NOV 23-6			
MT. RICHMOND	102.191 ✓	X= 685252.	22.
MT. WARRNAVBOOR	44.974	Y= 5694352.	
CROWES	17.219		
NOV 23-7			
MT. RICHMOND	102.255	X= 685281.	26.
MT. WARRNAVBOOR	45.075 ✓	Y= 5694180.	
CROWES	17.285		
NOV 23-8			
MT. RICHMOND	102.319 ✓	X= 685310.	27.
MT. WARRNAVBOOR	45.175	Y= 5694010.	
CROWES	17.344		
NOV 23-9			
MT. RICHMOND	102.383	X= 685353.	23.
MT. WARRNAVBOOR	45.264 ✓	Y= 5693842.	
CROWES	17.403		
NOV 23-10			
MT. RICHMOND	102.447 ✓	X= 685383.	23.
MT. WARRNAVBOOR	45.391	Y= 5693064.	
CROWES	17.470		

IX. BASIC CONTROL

The following Shoran base stations, along with their coordinates, were occupied to control this survey.

Universal Transverse Mercator Projection
Australian National Spheroid
Zone 54
Central Meridian 141° East
AUSTRALIAN GEODETIC DATUM

STATION CROWES:

Latitude	38°41'53"91 S	N = 5,714,057 meters
Longitude	143°21'13"98 E	E = 704,703 meters
Elevation	424 meters (Shoran tower 40 feet)	

STATION MOUNT RICHMOND:

Latitude	38°16'08"42 S	N = 5,764,241 meters
Longitude	141°24'59"89 E	E = 536,446 meters
Elevation	225 meters (Shoran tower 40 feet)	

STATION MOUNT WARRNAMBOOL:

Latitude	38°18'25"83 S	N = 5,758,658 meters
Longitude	142°44'18"21 E	E = 651,993 meters
Elevation	219 meters (Shoran tower 40 feet)	

SHORAN BASE STATION DESCRIPTIONS AND PLATES

- 34 -

STATION: CROWES

LOCATED: Station Crowes is located on the south central coast of Victoria, Australia.

ACCESS: There are two access routes to this site.

1. From the town of Colac, proceed south on the Beech Forest Road through Kawarren and Gellibrand to the junction of Great Ocean Road, a distance of approximately 29 miles. Turn right on Great Ocean Road. Continue on this road through Mt. Chappel and Lavers Hill. The trig. point is located approximately 1 1/2 miles south of Lavers Hill on the left side of the road. A fire tower is located on the righthand side of the road at this point. The trig. point marker is located in the center of a small sealed roundabout across the road from the fire tower and approximately 50 meters off the highway.

2. From the town of Warrnambool, proceed east along the Princess Highway through Allansford. Princess Highway intersects with the Great Ocean Highway at the eastern edge of Allanford. Take the Great Ocean Highway towards Peterborough and Port Campbell. Proceed through these towns and stay on the Great Ocean Highway towards Lavers Hill. From Princeton, the road climbs the mountain. Approximately 6 miles after passing a microwave relay tower on the right, you will come to a fire tower on the left. The station site is located on the righthand side of the road at this point.

MARKER: The trig. point is marked with a standard steel quadripod, approximately 15 feet high with a circular target on the top. A bronze plaque with a warning not to remove, is located below the steel frame.

STATION: CROWES (continued)

GENERAL: Water is available at the dairy located at the station site. This dairy and house to the south of the site belong to: I. Hider, Telephone 052-373242. Stores, petrol supplies, etc., should be brought in from either Warnnambool or Colac.

ELEVATION: 424 meters

SKETCH: See next page.

AUSTRALIAN GEODETIC DATUM

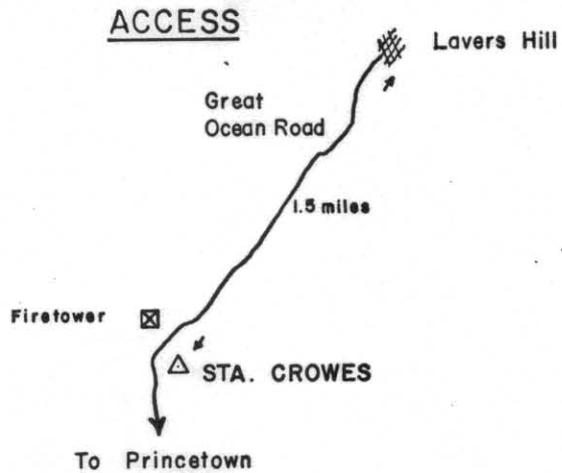
GEOGRAPHICAL COORDINATES		UTM PROJ., AUST. NAT. SPHEROID ZONE 54, C.M. 141° EAST	
Latitude	Longitude	North	East
38°41'53"91 S	143°21'13"98 E	5,714,057 meters	704,703 meters

STATION CROWES — AUSTRALIA

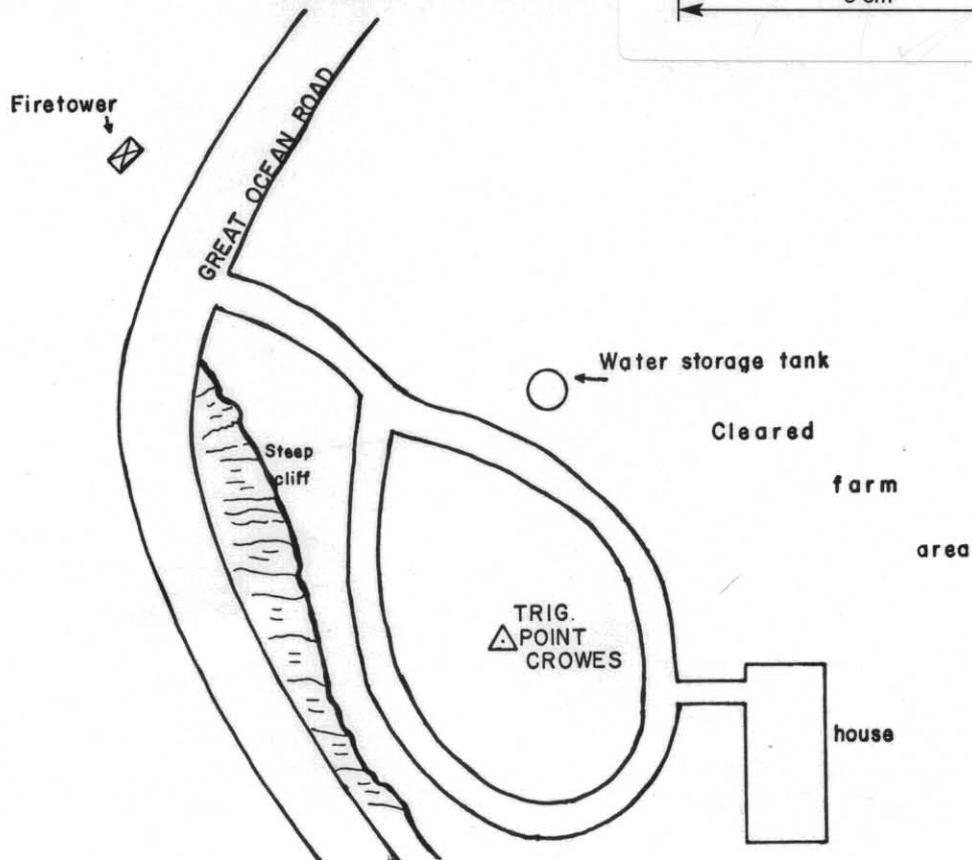
LAT. 38°41'53".91 S
LONG. 143°21'13".98 E
ELEV. 424 meters

N 5,714,057 meters
E 704,703 meters

UTM PROJECTION, AUST. NATIONAL SPHEROID
ZONE 54 C.M. 141° E.
AUSTRALIAN GEODETIC DATUM



MARKER DETAILS



STATION: MT. RICHMOND

LOCATED: Station Mt. Richmond is located on the west coast of Victoria, Australia.

ACCESS: From the post office in Portland, proceed north along the road to Heywood. After 2 miles turn left to the west onto the road to Nelson. At the "T" junction, Cashmore, Nelson, turn right and follow this bitumen road for another 9 1/2 miles, past the Gorae West School, to the turn-off to Mt. Richmond National Park. (This is signposted). Turn left towards the south and follow this gravel road for approximately 2 miles towards the W.S.W. At this point the road branches, one part continuing over a bridge while the other turns to the south and continues for another mile to the crossroads and the beginning of the access road into the National Park. Continue on up this road a further 1 1/2 miles to its termination. Here the trig. marker will be found.

MARKER: The trig. marker is marked by a normal steel quadripod and circular vanes. There is a bronze plaque at ground level stamped "GEODETIC SURVEY VICTORIA". There is an observation platform located at a bearing of 206° Magnetic from the trig. marker which gives an excellent view back over Portland and into Discovery Bay.

GENERAL: The station site is a picnic area of the National Park. Water and toilet facilities are available. Fuel and supplies should be brought in from Portland. There are probably telephone facilities at Gorae West. Medical facilities are available in Portland.

STATION: MT. RICHMOND (continued)

The National Park Service is to be notified and permission obtained in advance of occupying this station site.

Tree height on the station site is approximately 30 - 40 feet.

ELEVATION: 225 meters

SKETCH: See next page.

AUSTRALIAN GEODETIC DATUM

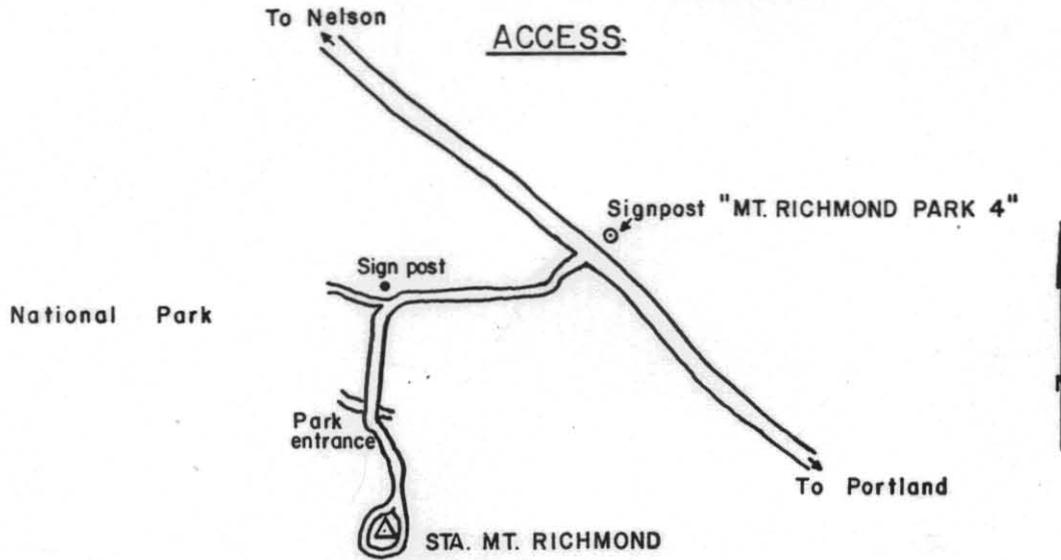
GEOGRAPHICAL COORDINATES		UTM PROJ., AUST. NAT. SPHEROID ZONE 54, C.M. 141° EAST	
Latitude	Longitude	North	East
38°16'08"42 S	141°24'59"89 E	5,764,241 meters	536,446 meters

STATION MT. RICHMOND — AUSTRALIA

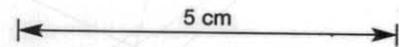
LAT. 38°16'08".42 S
LONG. 141°24'59".89 E
ELEV. 225 meters

N 5,764,241 meters
E 536,446 meters

UTM PROJECTION, AUST. NATIONAL SPHEROID
ZONE 54 C.M. 141° E.
AUSTRALIAN GEODETIC DATUM



MARKER DETAILS



Toilet facilities
☒

Lookout tower
□

☒ Bar-B-Q

○ water pipe

○ Old water loading

TRI
MARKER

Trees in area
20-30 feet high.



STATION: MT. WARRNAMBOOL

LOCATED: Station Mt. Warrnambool is located on the west coast of Victoria, Australia.

ACCESS: From the city of Warrnambool, proceed east along the Princess Highway through Allansford (approximately 7 miles) and Panmure (approximately 16 miles). Continue for a further one mile to the entrance of J. O'Donaghue's property which lies at the foot of Mt. Warrnambool. There is a gravel quarry on the eastern righthand side of the entrance. The trig. beacon can be seen on the hilltop from the road. The actual ascent road begins through O'Donaghue's dairy on the west side of the house and follow up around the feature running towards the west. This road is slippery during rain. The land on which the point lies, however, belongs to W. Bourke, whose main property lies on the south side of the highway, across from O'Donaghues.

MARKER: The station is marked by a normal steel quadripod with circular vanes. There is a forestry hut on the east side of the beacon.

GENERAL: Water can be obtained from O'Donaghues. Fuel and supplies should be brought in from somewhere else. The nearest re-supply point would be Panmure where there is also a post office. Medical care is available in Warrnambool.

It is suggested to check at the Shire Council in Warrnambool prior to departure. At times, strong winds are experienced on this mountain making access to the forestry hut difficult.

There is a telephone located at the farmhouse of Mr. Jerry Divall located at the bottom of the hill.

STATION: MT. WARRNAMBOOL (continued)

His number is 72-1197, Panmure, Victoria. A telephone can be installed at the station site.

ELEVATION: 219 meters

SKETCH: See next page.

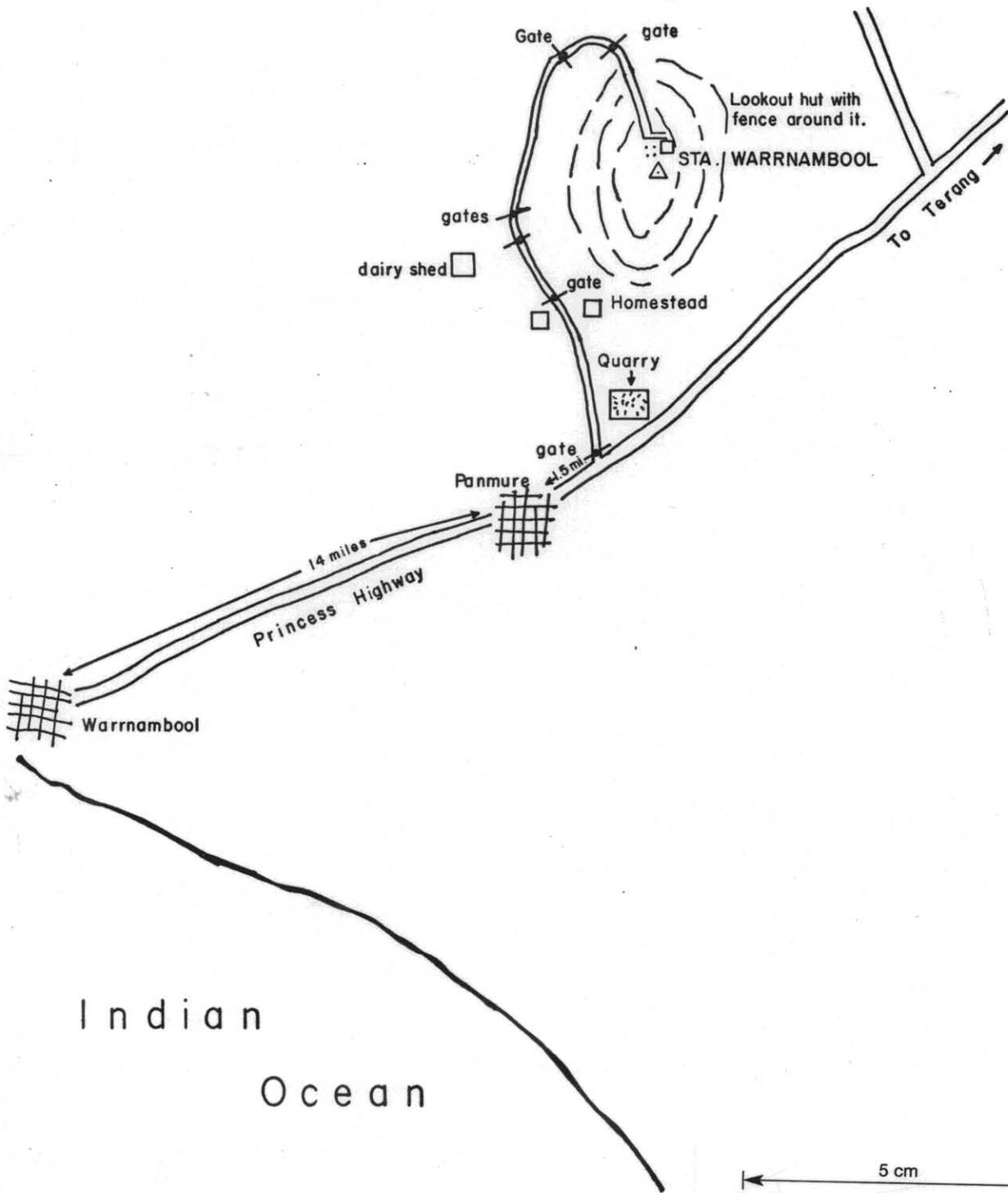
GEOGRAPHICAL COORDINATES		UTM PROJ., AUST. NAT. SPHEROID ZONE 54, C.M. 141° EAST	
Latitude	Longitude	North	East
38°18'25"83 S	142°44'18"21 E	5,758,658 meters	651,993 meters

STA. WARRNAMBOOL — AUSTRALIA

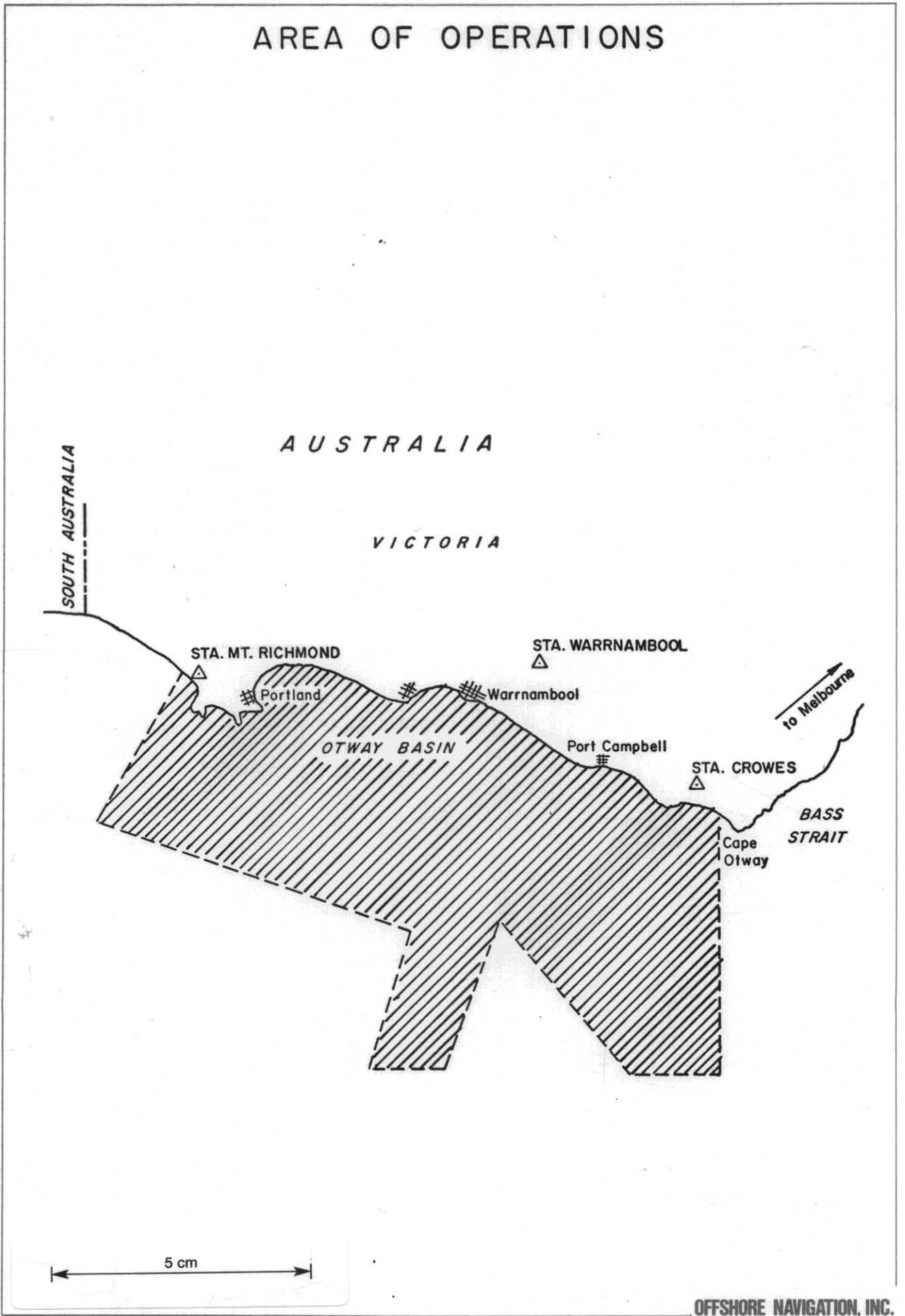
LAT. 38°18'25".83 S
LONG. 142°44'18".21 E
ELEV. 219 meters

N 5,758,658 meters
E 651,993 meters

UTM PROJECTION, AUST. NATIONAL SPHEROID
ZONE 54 C.M. 141° E.
AUSTRALIAN GEODETIC DATUM



AREA OF OPERATIONS



Increased Delay
By 2

OFFSHORE NAVIGATION, INC.
SHORAN CALIBRATION REPORT

Date: 15/1/74

Mobile Station Location	Base Station Location	Computed Slant Range
RICHMOND	WORNAMBOL	71.902 miles

MOBILE STATION			BASE STATION		
Operator: MCKENZIE			Operator: HACKENBRUCH		
UNIT	MODEL	SERIAL	UNIT	MODEL	SERIAL
Transmitter		ST-067	Transmitter	AUP-5	ST-31
Indicator		S.M-420	Monitor	AUG-5	S.M-35
Receiver		#122	Receiver		SR-233
Preamplifier		S.M-100 #013	Preamplifier		
Coaxial Cable	Type:	Length:	Coaxial Cable	Type:	Length:

Input voltage, AC	115	volts	Input voltage, AC	115	volts
Transmitter frequency	230/250	mc.	Transmitter frequency	300	mc.
Receiver frequency	300	mc.	Receiver frequency	230/250	mc.
Receiver gain setting	9		Receiver gain setting		
"Gain-riding" amplitude			"Gain-riding" amplitude		
"Zero set" reading	99.808	miles	"Test zero" reading		miles
Observed range, Rate - HF	71.904	miles	"Zero set" reading		miles
Observed range, Rate - LF	71.905	miles	Variable delay setting (counted clockwise from zero position)	10	

METEOROLOGICAL DATA	MOBILE STATION	BASE STATION
Atmospheric pressure (specify unit)		
Dry bulb temperature (degrees Fahrenheit)	18	18
Set bulb temperature (degrees Fahrenheit)		
General cloud conditions (type & % coverage)	OVERCAST	OVERCAST

NOTES REGARDING CALIBRATION PROCEDURES:

1. All equipment will be allowed to warm up for at least 30 minutes prior to calibrating.
2. All readings entered hereon will be final readings for the item in question, not preliminary or intermediate readings.
3. Each report will be complete in itself. Do not refer to other reports for information.
4. Use the reverse side of this report for any additional comments deemed necessary or advisable for completeness and clarity.

INCREASED BY
Delay 3 clicks

OFFSHORE NAVIGATION, INC.
SHORAN CALIBRATION REPORT

Date: 15/11/74

Mobile Station Location	Base Station Location	Computed Slant Range
RICHMOND	WARDNBOROUGH	71.902 miles

MOBILE STATION			BASE STATION		
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Operator: MCKENZIE			Operator: MACKENBOROUGH		
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UNIT	MODEL	SERIAL	UNIT	MODEL	SERIAL
Transmitter	APN-34	ST-067	Transmitter	APN-34	CRU-554
Indicator		SM-420	Monitor		CRU-11
Receiver		SR-122	Receiver		015
Preamplifier		SAM-OR#013	Preamplifier		SAL-181
Coaxial Cable	Type:	Length:	Coaxial Cable	Type:	Length:

Input voltage, AC ... 115 volts	Input voltage, AC ... 115 volts
Transmitter frequency 230/250 mc.	Transmitter frequency 300 mc.
Receiver frequency 300 mc.	Receiver frequency 230/250 mc.
Receiver gain setting 9	Receiver gain setting
"Gain-riding" amplitude	"Gain-riding" amplitude
"Zero set" reading 99.909 miles	"Test zero" reading
Observed range, Rate - HF 71.903 miles	"Zero set" reading
Observed range, Rate - LF 71.903 miles	Variable delay setting (counted clockwise from zero position) 11

METEOROLOGICAL DATA	MOBILE STATION	BASE STATION
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Atmospheric pressure (specify unit).....	—	—
Dry bulb temperature (degrees Fahrenheit)....	18	18
Set bulb temperature (degrees Fahrenheit)....	—	—
General cloud conditions (type & % coverage)....	OVERCAST	OVERCAST

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*Increased delay
Two clicks*

OFFSHORE NAVIGATION, INC.
SHORAN CALIBRATION REPORT

Date: *15/1/74*

Mobile Station Location	Base Station Location	Computed Slant Range
<i>RICHMOND</i>	<i>WARRINGTON</i>	<i>71.902</i> miles

MOBILE STATION			BASE STATION		
Operator: <i>McKenzie</i>			Operator: <i>Hockenbrugh</i>		
UNIT	MODEL	SERIAL	UNIT	MODEL	SERIAL
Transmitter	<i>ST-267</i>	Transmitter	.....	<i>ST-168</i>
Indicator	<i>SM-420</i>	Monitor	.....	<i>SM-17</i>
Receiver	<i>SR-#122</i>	Receiver	.....	<i>SR-453</i>
Preamplifier	<i>SAM-02 #013</i>	Preamplifier	.....
Coaxial Cable	Type:	Length:	Coaxial Cable	Type:	Length:

Input voltage, AC ... *115*..... volts
 Transmitter frequency *230/250*..... mc.
 Receiver frequency ... *300*..... mc.
 Receiver gain setting ... *9*.....
 "Gain-riding" amplitude
 "Zero set" reading ... *99.808*..... miles
 Observed range, Rate - HF *71.903*..... miles
 Observed range, Rate - LF *71.903*..... miles

Input voltage, AC ... *115*..... volts
 Transmitter frequency ... *300*..... mc.
 Receiver frequency ... *230/250*..... mc.
 Receiver gain setting
 "Gain-riding" amplitude
 "Test zero" reading miles
 "Zero set" reading miles
 Variable delay setting (counted clockwise from zero position) ... *9*.....

METEOROLOGICAL DATA	MOBILE STATION	BASE STATION
Atmospheric pressure (specify unit).....	.....	.....
Dry bulb temperature (degrees Fahrenheit).....	<i>18</i>	<i>18</i>
Set bulb temperature (degrees Fahrenheit).....
General cloud conditions (type & % coverage)....	<i>OVERCAST</i>	<i>OVERCAST</i>

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OFFSHORE NAVIGATION, INC.
SHORAN CALIBRATION REPORT

Date: 15/11/74

Mobile Station Location	Base Station Location	Computed Slant Range
RICHMOND	WDRNAMRODL	71.902 miles

MOBILE STATION			BASE STATION		
Operator: MCKENZIE			Operator: MCKENZIE		
UNIT	MODEL	SERIAL	UNIT	MODEL	SERIAL
Transmitter	APN-84	ST-067	Transmitter		CRV-839
Indicator		SM-420	Monitor		CRV-728
Receiver		SRT-122	Receiver		CR 070
Preamplifier		SAM-08-F013	Preamplifier		SAM-08-F19
Coaxial Cable	Type:	Length:	Coaxial Cable	Type:	Length:

Input voltage, AC ... 115 ... volts	Input voltage, AC ... 115 ... volts
Transmitter frequency 230/250 mc.	Transmitter frequency 300 mc.
Receiver frequency 300 mc.	Receiver frequency 230/250 mc.
Receiver gain setting 9	Receiver gain setting
"Gain-riding" amplitude	"Gain-riding" amplitude
"Zero set" reading 99.909 miles	"Test zero" reading
Observed range, Rate - HF 71.900 miles	"Zero set" reading
Observed range, Rate - LF 71.900 miles	Variable delay setting (counted clockwise from zero position) 6

METEROLOGICAL DATA	MOBILE STATION	BASE STATION
Atmospheric pressure (specify unit).....		
Dry bulb temperature (degrees Fahrenheit)....	18	
Set bulb temperature (degrees Fahrenheit)....		
General cloud conditions (type & % coverage)....	OVERCAST	

NOTES REGARDING CALIBRATION PROCEDURES:

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OFFSHORE NAVIGATION, INC.
SHORAN CALIBRATION REPORT

Date: 15/11/24

Mobile Station Location	Base Station Location	Computed Slant Range
TRIPIC MOND	WARNAMBOOL	71.902 miles

MOBILE STATION			BASE STATION		
Operator: MCKENZIE			Operator: HOCKENBLUCH		
UNIT	MODEL	SERIAL	UNIT	MODEL	SERIAL
Transmitter	ST-110	Transmitter	.....	ST-251
Indicator	SM-044	Monitor	.....	SM-48
Receiver	11790	Receiver	.....	253
Preamplifier	Type:	Length:	Preamplifier	Type:	Length:
Coaxial Cable	Coaxial Cable	.....	.....

Input voltage, AC 115 volts	Input voltage, AC volts
Transmitter frequency mc.	Transmitter frequency mc.
Receiver frequency mc.	Receiver frequency mc.
Receiver gain setting	Receiver gain setting
"Gain-riding" amplitude	"Gain-riding" amplitude
"Zero set" reading miles	"Test zero" reading miles
Observed range, Rate - HF 71.912 miles	"Zero set" reading miles
Observed range, Rate - LF 71.913 miles	Variable delay setting (counted clockwise from zero position).....

METEOROLOGICAL DATA	MOBILE STATION	BASE STATION
Atmospheric pressure (specify unit).....
Dry bulb temperature (degrees Fahrenheit).....
Set bulb temperature (degrees Fahrenheit).....
General cloud conditions (type & % coverage)...

NOTES REGARDING CALIBRATION PROCEDURES:

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Decreased delay
By 2 clicksOFFSHORE NAVIGATION, INC.
SHORAN CALIBRATION REPORT

- 49 -

Date: 1-11-62

Mobile Station Location	Base Station Location	Computed Slant Range
Dickman 0	WARREN BPOOL	71.902 miles

MOBILE STATION			BASE STATION		
Operator:			Operator:		
UNIT	MODEL	SERIAL	UNIT	MODEL	SERIAL
Transmitter		ST-067	Transmitter		ST-251
Indicator		SM-420	Monitor	C.P.N-2	SM-48
Receiver		#122	Receiver		SR-363
Preamplifier		SAM-02 #013	Preamplifier		181 SAB-001
Coaxial Cable	Type:	Length:	Coaxial Cable	Type:	Length:

Input voltage, AC 115 volts

Transmitter frequency .. 230/250 mc.

Receiver frequency .. 300 mc.

Receiver gain setting

"Gain-riding" amplitude

"Zero set" reading ^{SHORT} 99.808 milesObserved range, Rate - HF ^{GATE IN} 71.904 miles

Observed range, Rate - LF 71.906 miles

Input voltage, AC 115 volts

Transmitter frequency .. 300 mc.

Receiver frequency .. 230/250 mc.

Receiver gain setting

"Gain-riding" amplitude

"Test zero" reading

"Zero set" reading

Variable delay setting (counted clockwise from zero position)..... 9

METEOROLOGICAL DATA	MOBILE STATION	BASE STATION
Atmospheric pressure (specify unit).....	.....	.....
Dry bulb temperature (degrees Fahrenheit).....	18	18
Set bulb temperature (degrees Fahrenheit).....	.....	.....
General cloud conditions (type & % coverage).....	OVERCAST	OVERCAST

NOTES REGARDING CALIBRATION PROCEDURES:

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INCREASED DELAY
BY 3 clicks

OFFSHORE NAVIGATION, INC.
SHORAN CALIBRATION REPORT

Date: 15/8/24

Mobile Station Location	Base Station Location	Computed Slant Range
RICHMOND	WOODENHOB	71.902 miles

MOBILE STATION			BASE STATION		
Operator: MC KENZIE			Operator: FRANK HOCKENBERG		
UNIT	MODEL	SERIAL	UNIT	MODEL	SERIAL
Transmitter		STA-067	Transmitter		CRV-283
Indicator		SM-420	Monitor	A	CRV-309
Receiver		#122	Receiver		#127
Preamplifier		SOM-02#013	Preamplifier		181
Coaxial Cable	Type:	Length:	Coaxial Cable	Type:	Length:

Input voltage, AC	115	volts	Input voltage, AC	115	volts
Transmitter frequency		mc.	Transmitter frequency	300	mc.
Receiver frequency		mc.	Receiver frequency	230/250	mc.
Receiver gain setting	9		Receiver gain setting	6	
"Gain-riding" amplitude			"Gain-riding" amplitude		
"Zero set" reading		miles	"Test zero" reading		miles
Observed range, Rate - HF	71.903	miles	"Zero set" reading		miles
Observed range, Rate - LF	71.903	miles	Variable delay setting (counted clockwise from zero position)	12	

METEROLOGICAL DATA	MOBILE STATION	BASE STATION
Atmospheric pressure (specify unit)		
Dry bulb temperature (degrees Fahrenheit)	18	
Set bulb temperature (degrees Fahrenheit)		
General cloud conditions (type & % coverage)	cloudy	

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