FINAL REPORT
PROJECT 85 AND 117
WESTERN GEOPHYSICAL COMPANY
NORTHWEST COAST OF AUSTRALIA
OFFSHORE NAVIGATION &
OFFSHORE RAYDIST, INC.
OCTOBER, 1964

FINAL REPORT

PROJECTS 85 and 117

for

WESTERN GEOPHYSICAL COMPANY OF AMERICA

IN

NORTHWEST COAST OF AUSTRALIA

OP2

BY

OFFSHORE NAVIGATION, INC.

and

OFFSHORE RAYDIST, INC.

OCTOBER, 1964

ABSTRACT

Projects 85 and 117 were both a Shoran and a Raydist positioned and controlled marine seismic survey for potential mineral deposits along the Northwest coast of Australia. Project 85 was a Shoran operation, while Project 117 was a Type N Raydist controlled survey. The Principal involved was AQUITANE PETROLEUM PTY., LTD. (AQUITANE). The prime contractor and operator was WESTERN GEOPHYSICAL COMPANY OF AMERICA (WESTERN). The Horizontal Control was furnished by OFFSHORE NAVIGATION, INC. (ONI) and OFFSHORE RAYDIST, INC. (ORI).

The attached report considers the following:

(1) A Description of the Shoran System.

(2) A Description of the Raydist System.

(3) The area of Operations.

(4) A Field Operations Recap.

(5) Materials Furnished.

(6) Basic Control and Mapping.

Also included is a list of personnel and sketches of the work area which illustrate base station positions and the approximate program location.

I. DESCRIPTION OF SHORAN SYSTEM:

The Shoran system determines the distance of the vessel from two base stations by measuring the time required for radio signals to travel from the vessel to each base station and back to the vessel. These time intervals can be related to corresponding distances in a simple manner because the velocity of radio waves in air remains constant.

Pulse signals originating at the indicating station in the vessel are radiated from this mobile station transmitter and received by one of the base stations. At the base station, the pulse is sent from the output of the receiver to the input of the transmitter, and the pulse is then re-transmitted back to the mobile or indicating station. After passing through the indicating station receiver, the pulse is routed to a circuit in which its time lag or loss, with respect to the original outgoing pulse, may be determined. This time lag is indicated directly in terms of statute miles (read to 1/1000 of a mile) rather than units of time.

Other pulses are transmitted to the second base station by using a different carrier frequency to permit their discrimination from those intended for the first base

I. DESCRIPTION OF SHORAN SYSTEM (continued):

station. These pulses are received and re-transmitted by the second base station, and, on their return to the indicating station, they are likewise sent through circuits for measurement of the time required for their round trip. Thus the equipment provides, simultaneously, indications of the distance of the indicating station to the two base stations. The system accuracy can be expected to be within 50 to 75 feet on any one distance. The accuracy of each location or fix is dependent on the angle of intersection formed by the two arcs of distance at the indicating station. In addition, the overall accuracy of the survey is directly related to the accuracy of the basic control used to tie in the Shoran base station locations.

II. DESCRIPTION OF TYPE N RAYDIST SYSTEM:

The Raydist radiolocation method of horizontal control employs the principle of a continuous wave phase comparison system in which pairs of transmitters located on shore generate hyperbolic lines of position. Receiving and phase comparison equipment aboard the geophysical instrument boat records the intersection of two such lines

II. DESCRIPTION OF TYPE N RAYDIST SYSTEM (continued):

of position, thus determining a point of position.

In a continuous wave phase comparison system such as Raydist, the phase comparison instruments will read accurately any fraction of a lane formed by two lines of position. However, it is impossible with phase meters alone to determine the correct lane that is being read. Thus arises the problem of "lane counting" or "lane identification'. This situation is solved by use of a two channel continuously operating magnetic oscillograph. The pens of the oscillograph are driven from small potentiometers connected directly to the shafts of the phase meters. As the phase meter moves through 360 degrees of rotation, the pens will trace a readily identifiable sawtooth pattern on the oscillograph tape. By beginning at a known location point in the Raydist system with the correct lane count and adding or subtracting lanes each time the phase meter goes through 360 degrees of rotation, as shown on the oscillograph tape, the Raydist operator is able to properly identify each lane occupied.

As a further aid to positive lane identification, this party also employs the use of an additional unit of Raydist receiving and phase comparison equipment aboard a

II. DESCRIPTION OF TYPE N RAYDIST SYSTEM (continued):

separate survey boat. At frequent intervals throughout the work period, the survey boat would carry a lane count from a known point in the system out to the seismic boat. This was invaluable in that it not only served as a check on the lane count of the seismic boat but also on the fractional readings between the lanes.

The final product of the Raydist survey in connection with the seismic operation is to present on a map of suitable scale the individual locations at the center or end of the seismic cable at the instant of each shot. With this purpose in mind, a system of precomputations and post-plotting of Raydist hyperbolic readings of each seismic boat location were mathematically determined and the Raydist operator aboard the seismic boat, after having directed the boat as close as possible to these predetermined locations, recorded the actual Raydist hyperbolic readings. With this information, the location of each boat position was plotted on Raydist hyperbolic charts. A correction for distance from the Raydist receiving antenna to the center of the seismic cable presented the final seismic cable center position.

III. THE AREA OF OPERATIONS:

A. The surveyed areas were separated into two distinct parts, and surveying was accomplished by both Raydist and Shoran methods. The Shoran controlled area was confined totally to the limits of the Joseph Bonaparte Gulf from Cape Pearce to approximately 10 miles southwest of Turtle Point.

The Raydist controlled area consisted of 3 lines (1) a line QC-9 which was due west from Cape Hay and which ran east and west, (2) a line QC-10 which began approximately 15 miles north of Cape Hay and which ran 100 miles to the north to 12° latitude, (3) a line QC-11 which ran east and west and from 129° to 130° 15' longitude.

B. The base of operations was established in Darwin. Space for the ONI and ORI field and drafting office was provided by Western in their Darwin Office.

IV. FIELD OPERATIONS RECAP:

On May 15, 1964, the personnel of ONI (the Shoran crew) arrived in Darwin. The Western boats, the M/V Oil Creek (recording) and the M/V Bluff Creek (shooting) arrived in Darwin and unloaded the Shoran equipment on May 17, 1964.

IV. FIELD OPERATIONS RECAP: (continued)

From May 18 through May 24, 1964, the Shoran equipment was moved to location by barge.

The first location, set on Quoin Island, was transported there by the barge "St. Joseph" and the second position was established at Turtle Point and transported there by the barge "Betty Jean". On May 24, 1964, the stations were operational. Actual seismic operations began on May 24, 1964, and continued until June 28, 1964, at which time the Shoran stations were dismantled and returned to Darwin.

On June 11, 1964, the Raydist Type N system arrived in Darwin. On June 15, 1964, the Raydist equipment was loaded on the lane count boat the "Nelma". On June 17, 1964, the M/V Nelma, with Raydist personnel aboard, left Darwin to establish the Raydist system. On June 20, the Raydist Red station was established on Lesueur Island. The Relay station on Cape Ford was established on June 23. On June 23, 1964 the Green station on Cape Fourcroy was operational.

Actual seismic operations began on June 29, 1964, when the M/V Oil Creek (recording) and the M/V Bluff Creek (Shooting), with the M/V Nelma, as lane count boat, with Raydist equipment installed and operating entered the work

IV. FIELD OPERATIONS RECAP (continued):

area. The seismic operations were completed on July 11, 1964.

V. MAPS AND DATA FURNISHED:

A total of 1221 shot points were surveyed with the Type N Raydist system, and an approximate total of 850 shot points were positioned by Shoran.

A. Base charts of stable material, at a scale of 1:50,000 using the Australian Transverse Mercator Projection were constructed in New Orleans. All shot point locations were postplotted in New Orleans.

B. Final coordinates for all surveyed shot point positions were computed by IBM from original field notes. The final charts were completed in New Orleans and transmitted to Western's office in Shreveport, Louisiana.

VI. BASIC CONTROL AND MAPPING:

A. Prior to the start of the survey, positions for the Shoran base stations were taken from an Australian series of Quadrangle maps of the area around Joseph Bonaparte Bay (scale 1:1,000,000). Since these positions were unsurveyed, their reliability was

VI. BASIC CONTROL AND MAPPING (continued):

doubtful, from the beginning of the survey. However, since there was no basic control in the area, it was necessary to use these map positions in order to pre-plot the assigned program.

B. During the course of the survey the recording boat passed through the base line at Stations 1 and 2 and through the base line at Station 3 and 4. These base line crossings (which determine distance by reading minimums) showed that the stations were not in the correct position in relation to each other. In order to establish correct relative positions, Stations 1 and 4 were moved outward in order to coincide with the base line readings.

After these adjustments were made to the map positions, the program was recomputed on the basis of relative position of shot point to shot point from the four base station set-ups involved - Station 1 and Station 2, Station 2 and Station 3, Station 3 and Station 4, Station 2 and Station 4. Because of the complete unreliability of the geographic positions of the base stations at this time, no geographic positions for the program were given and only the shot point relationship

VI. BASIC CONTROL AND MAPPING (continued):

of the program was plotted on charts at a scale of 1:50,000.

C. At a later date, published maps of the area at a scale of 1:48,000, based on photo control points became available on which the four Shoran Base stations were spotted and adjustments made for the two base line crossings. Using these new coordinates, the entire program was recomputed and replotted at a scale of 1:100,000. As these published maps of 1:48,000 represent the best basic control available the program was assigned geographic positions and represents final map positions. Coordinates assigned to the Shoran base stations in this report represent those derived from the 1:48,000 map series.

D. The Raydist system was located upon three positions which were established by Astro fixes. The coordinate positions therefore are reliable.

Since Raydist is dependent upon a calibration and a daily lane count, calibration of the mobile equipment was accomplished by checking the zero readings at an extension of each base line near the center station.

VI. BASIC CONTROL AND MAPPING (continued):

After the equipment was calibrated two buoys were set and Red and Green readings were taken for both buoys. These buoys then became calibration or check points from which the equipment could be checked periodically throughout the work period.

E. The postplotting of the Raydist controlled portion of the prospect was accomplished in New Orleans and a stepback of 1372 meters was used in order to locate the position of each shot. The Shoran portion was postplotted by taking the shooting boat position where the shot was fired.

F. Following is a list of station coordinates and descriptions:

(1) SHORAN STATION NO. 1:

Latitude - 14° 58' 55.82" X = 777,775
Longitude - 129° 06' 40.14" Y = 3,102,830

Shoran Station No. 1 is located southwest of Turtle point, approximately 10 miles across the bay formed by Keep River. This station is about 190 miles southwest of Darwin.

VI. BASIC CONTROL AND MAPPING (continued):

(2) SHORAN STATION NO. 2:

Latitude - 14° 51' 29.537" S X = 790,307
Longitude- 129° 13' 07.190" E Y = 3,117,941

Shoran Station No. 2 is located on Turtle Point, which lies approximately 180 miles southwest of Darwin. Turtle point is a prominent point which projects north into Joseph Bonaparte Gulf.

(3) SHORAN STATION NO. 3:

Latitude = 14° 47' 31.876" S X = 822,975
Longitude- 129° 29' 47.661" E Y = 3,126,172

Shoran Station No. 3 is located on the north tip of Quoin Island, which lies in the southeast portion of Joseph Bonaparte Gulf. This station is approximately 170 miles from Darwin.

(4) SHORAN STATION NO. 4:

Latitude = 14° 25' 37.93" S X = 806,107
Longitude= 129° 21' 21.83" E Y = 3,170,233

Shoran Station No. 4 is located on the extreme west end of Pearce Point, which is about 150 miles southwest of Darwin and is situated at the north end of Joseph Bonaparte Gulf.

VI. BASIC CONTROL AND MAPPING (continued):

(5) RAYDIST GREEN STATION:

Latitude = 11°45' 31" S X = 884,266
Longitude= 130°01' 45" E Y = 3,493,578

The Raydist Green Station is located at the site of an old World War II depot which is located on Cape Fourcroy on the extreme west end of Bathurst Island. To reach this station, it is necessary to leave Darwin by boat and travel northwest approximately 60 miles to Cape Fourcroy. At a point 3 miles north of Cape Fourcroy Lighthouse cliffs were blown out and a beach was formed. Here, in the only place where a landing can be effected, the station was located.

(6) RAYDIST CENTER STATION:

Latitude - 13° 30' 47" S X = 860,448
Longitude- 129° 49' 17" E Y = 3,281,195

The Raydist center station is located on Cape Scott, a prominent cape on the south end of Anson Bay. To reach Cape Scott from Darwin it is necessary to travel southwest by boat a distance of approximately 90 miles. Upon reaching Cape Ford it is necessary

VI. BASIC CONTROL AND MAPPING (continued):

to enter a small bay between Cape Ford and Cape Scott and proceed past a rocky point for 1 mile along a sandy beach. The boat must proceed as closely as possible along the north beach, for about 1 mile. At this place, about 1 mile from the tip of the rocky point, a landing may be made. The station site is located approximately one mile from the sea end of Cape Scott. A cement marker was placed at the location of the Raydist antenna.

(7) RAYDIST RED STATION:

Latitude - 13° 49' 09" S X = 559,102
Longitude= 127° 16' 25" E Y = 3,241,066

The Raydist Red station is located on the extreme east end of Lasueur Island, which is approximately 250 miles south-southwest of Darwin near Cape Londonderry. There is a light on the west end of this island. The station is located on the east end of the island approximately one mile from the light. A cement marker was left at the site of the antenna.

LIST OF PERSONNEL:

PROJECT 85 (Shoran):

Karel Kovacic	Supervisor
Ted Patro	Mobile Operator
Al Convenuto	Mobile Operator
Don Heaverlo	Base Station Operator
Donald Petterson	Base Station Operator

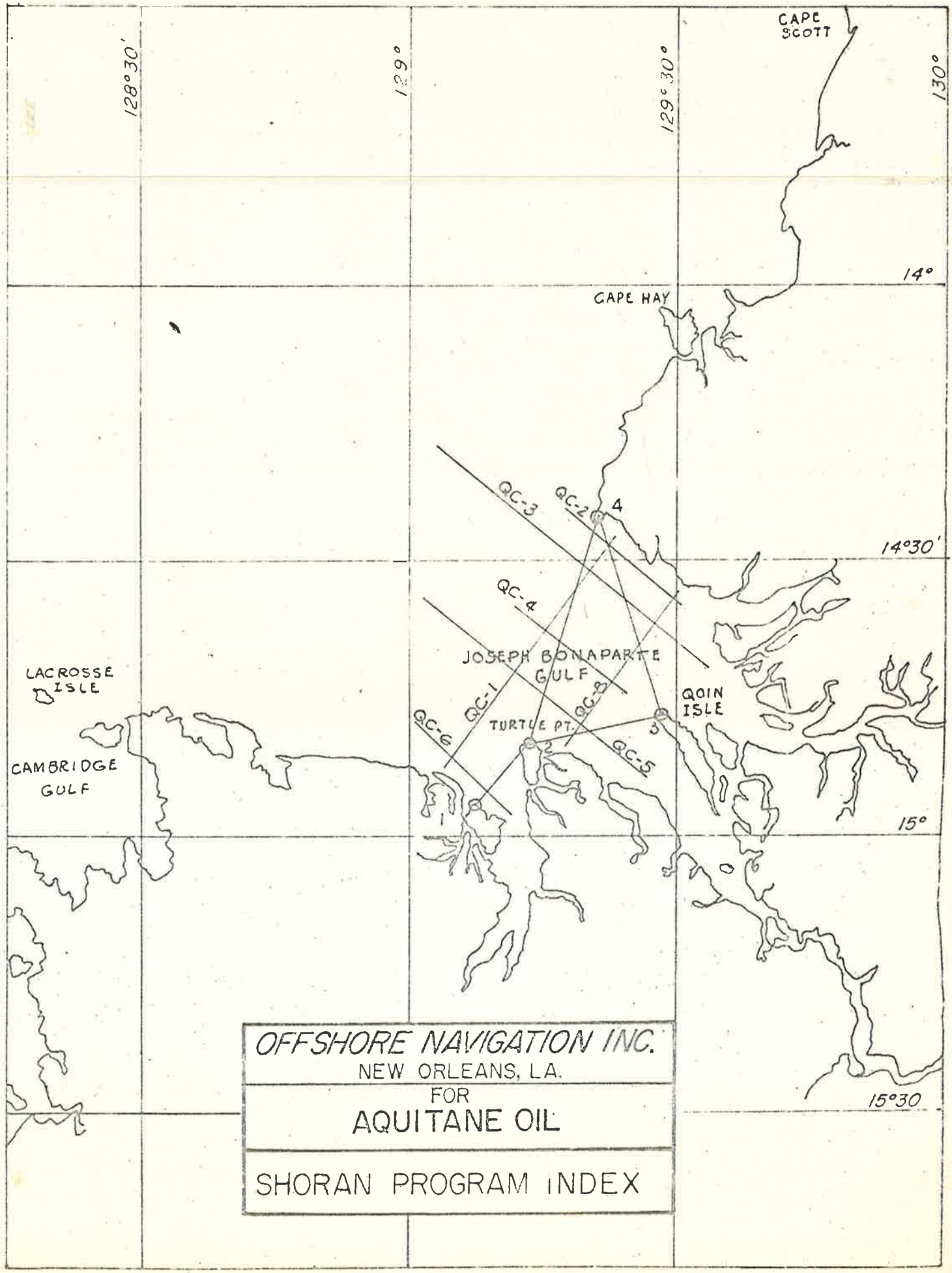
PROJECT 117 (Type N Raydist):

Karel Kovacic	Supervisor
Tom Mestayer	Raydist Technician
Ted Patro	First Operator
Al Convenuto	Second Operator
Don Heaverlo	Lane Count Operator
George Ferguson	Red Station
Sam Sain	Center Station
David Carpenter	Relay Station
Donald Petterson	Green Station

DISTRIBUTION:

Western Geophysical Company - 4 copies

Offshore Navigation, Inc. - 2 copies



OFFSHORE NAVIGATION INC.

NEW ORLEANS, LA.

FOR

AQUITANE OIL

SHORAN PROGRAM INDEX

127°
127°30'
128°
128°30'
129°
129°30'
130°
11°30'
12°
12°30'
13°
13°30'
14°
14°30'
15°
15°30'
16°

GREEN
X = 884,266
Y = 3,493,578

T I M O R S E A

PERON ISLES
ANSON BAY
CENTER
X = 860,488
Y = 3,281,195
CAPE FORD
CAPE SCOTT

RED
X=559,102
Y=3,241,066
LESUEUR ISLE
CAPE RULHIERES
CAPE BERNIER
CAPE HAY
THURBERN BLUFF
LACROSSE ILSE
CAMBRIDGE GULF
JOS. BONAPARTE GULF
TURTLE PT.
QOIN ISLE

OFFSHORE RAYDIST INC.

NORTH-WEST AUSTRALIA

NET 1

SCALE - 1:1,000,000