CO-OPERATIVE REPUBLIC OF GUYANA

EXPLORATION LICENCE: SATIRA

1988/89 WORK PROGRAMME AND BUDGET

LASMO OIL (GUYANA) LTD.
BHP PETROLEUM (GUYANA) INC.

16TH NOVEMBER 1988

EXPLORATION LICENCE: SATIRA

1988/89 WORK PROGRAMME AND BUDGET

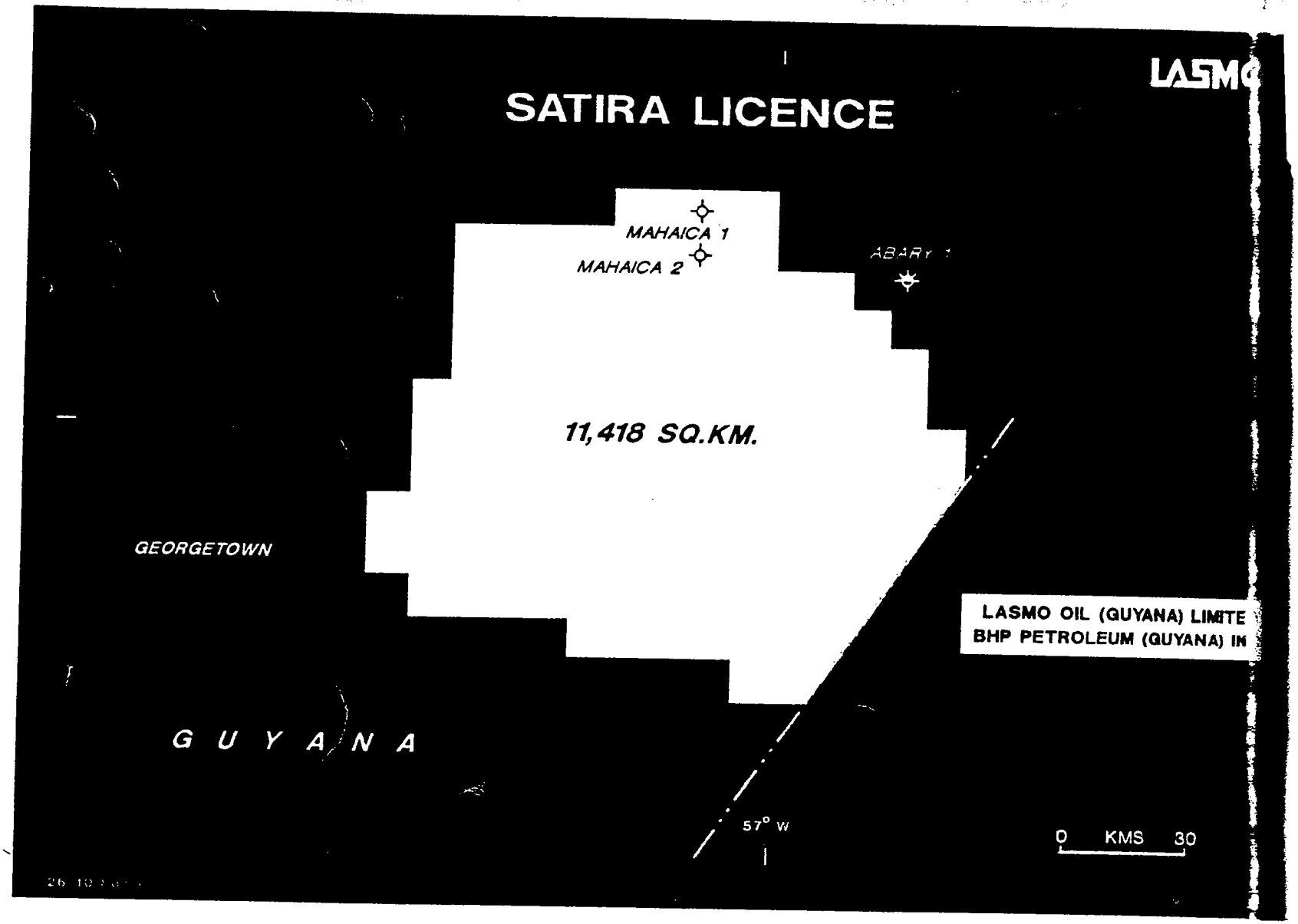
CONTENTS

LICENCE DETAILS SCHEDULE 1

Working interests	LASMO Oil (Guyana) Ltd. 60% Operator BHP Petroleum (Guyana) Inc. 40%
Location	Offshore, Guyana Basin
Effective Date	26th August 1988
Expiry Date	August 1997
Area	11,418 Square Kilometres
Water Depth	Up to 80 metres
Distance from Shore	Up to 130 Kilometres
Relinquishments	One Sixth of original area after 3 years One sixth of original area after 4 1/2 years One third of original area after 6 years
Rentals	Initial period US $4 per Sq.Km. per year First renewal US $6 per Sq.Km. per year Second Renewal US $12 per Sq.Km. per year

WORK COMMITMENT

Initial period - 3 years - (Aug 88 - Aug 91)	Acquire 2000 kilometres seismic (Min 3300 Km)
First renewal - 3 years - (Aug 91 - Aug 94)	Drill 1 well during first 18 months Option to withdraw Drill 1 well during second 18 months
Second renewal - 3 years - (Aug 94 - Aug 97)	Drill 2 wells Option to withdraw after 1st well


SATIRA LICENCE
LASMO
MAHAICA 1
MAHAICA 2
ABARY 1
11,418 SQ.KM.
GEORGETOWN
LASMO OIL (GUYANA) LIMITE
BHP PETROLEUM (GUYANA) IN
G U Y A N A
57° W
0 KMS 30

LAGMO

SUMMARY OF ESTIMATED PRE-CONTRACT COSTS

SCHEDULE 2

	US $(000)
Operator's Manpower	621
Direct Costs	443
ECL Reports	81
PETREL Charges	221
GB Petroleum Consultants	15
Application Fee	2
Total	1383

Note: By agreement, for cost recovery purposes the ceiling on pre-contract costs is US $1,250,000.

1988/89 WORK PROGRAMME SCHEDULE 3

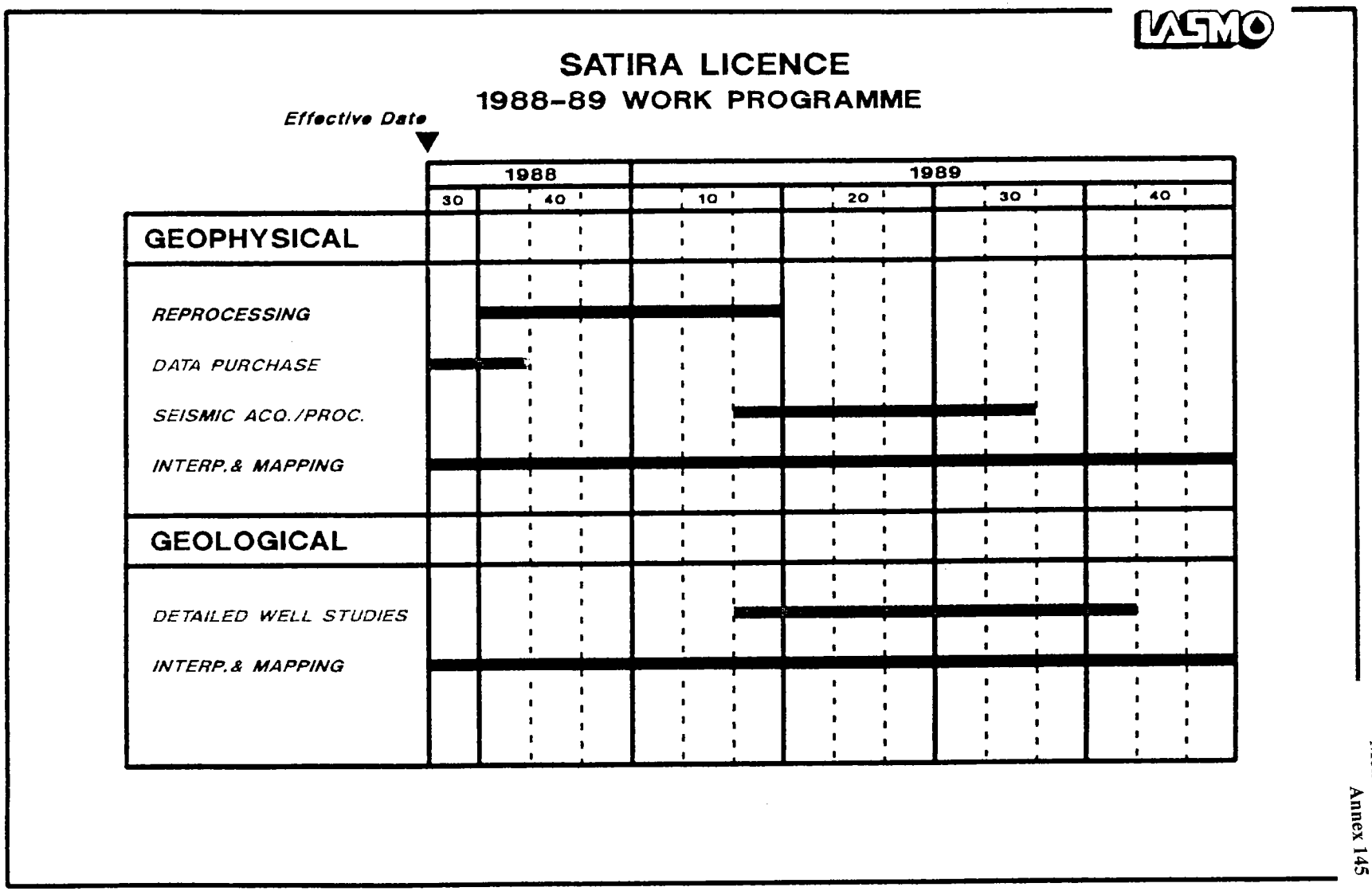
The main elements which constitute the 1988/89 work programme are:-

- reprocessing and interpretation of existing seismic data
- acquisition, processing and interpretation of 2000 km commitment seismic survey
- detailed geological studies of available well data

The reprocessing and interpretation of existing seismic data is seen as an important first-step in the evaluation of the licence. An interpretation based on reprocessed, migrated data will help confirm existing leads and provide a reliable basis for planning the new seismic programme, both in terms of line layout and choice of acquisition parameters.

This initial phase of activity should be completed within six to nine months of the licence award, after which the commitment seismic programme will be shot (1st/2nd quarter 1989).

During 1989, it is anticipated that detailed studies (paleontological, sedimentological and geochemical) of relevant well data will be undertaken to enhance the exploration evaluation of the licence.


LASMO
SATIRA LICENCE
1988–89 WORK PROGRAMME
Effective Date
1988
1989
30
40
10
20
30
40
GEOPHYSICAL
REPROCESSING
DATA PURCHASE
SEISMIC ACQ./PROC.
INTERP.& MAPPING
GEOLOGICAL
DETAILED WELL STUDIES
INTERP.& MAPPING

REVIEW OF 1988 EXPLORATION ACTIVITIES SCHEDULE 4

1. DATA AVAILABILITY

An investigation into the availability of field tapes from previous seismic surveys has shown that a good proportion of existing data is available for either purchase or trade.

Seagull-Denison Surveys (1981/82) - Field tapes for these surveys are held by the GNRA in Georgetown. These have been shipped to the United Kingdom for cleaning and retensioning.

Shell Surveys (1965-1973) - Shell have confirmed that field tapes from the 1971 and 1973 surveys are available, but prefer to trade, rather than sell the data. Negotiations with Shell are continuing.

Oxoco Surveys (1971/73) - Field tapes from the 500 km, 1973 survey are available for purchase.

2. SEISMIC REPROCESSING

Quotations for trial reprocessing of up to 120 km of data from the 1981/82 Seagull Denison surveys have been sought from three UK-based processing contractors (Ensign, Spectrum and GSI). Reprocessing trials are expected to commence in late November once the contractor has been chosen and the field tapes are available.

3. GRAVITY AND MAGNETIC DATA

A limited amount of gravity and magnetic data was acquired during the 1981/82 Seagull-Denison seismic surveys. The availability, cost and potential use of this, and other more regional data is currently under investigation.

4. GEOPHYSICAL AND GEOLOGICAL EVALUATION

Licence evaluation is underway and will take place concurrently with the reprocessing trials.

SCHEDULE 5

1988 EXPLORATION BUDGET SUMMARY

1. Exploration Costs	US $(000)
Seismic Reprocessing	10
Data Purchase	40
Manpower	225
Computing	30
Other Direct Charges	175
Total Exploration	480

2. General and Administrative Costs	
Local Office	25
Licence Rental	15
Training	17
Annual Overhead Charge	27
Total General and Administrative	84
Total 1988 Budget	564

NOTES TO 1988 EXPLORATION BUDGET

SCHEDULE 6

1. Seismic Reprocessing

Trial reprocessing of a limited amount of data from the 1981/82 Seagull-Denison surveys will be undertaken using a UK-based contractor. The results of this exercise will help determine whether further reprocessing is justified, and will provide useful information regarding acquisition parameters.

2. Data Purchase

Budget funds are allocated to purchase existing data for reprocessing (other than from the 1981/82 Seagull-Denison surveys) together with other relevant geophysical and geological data.

3. Manpower

Exploration staff in London will carry out evaluation studies, with support from financial and legal staff. Estimated manpower requirements are:-

	Man Months
Exploration	8
Draughting	2
Legal	1
Finance	1

4. Computing

Associated with seismic and well databasing, base map generation etc.

5. Other Direct Charges

The budgeted amount comprises:-

$25,000 - primarily associated with travelling, but including data storage, drawing office reprographics, etc.

$150,000 - payable as a bonus to PETREL on award of the licence.

6. Local Office

LASMO will initially employ a local representative and accounting firm to manage the Joint Venture affairs. These costs are allocated to local office costs.

7. Annual Overhead Charge

Calculated according to article 2.5 (b), Annex E of the Petroleum Agreement.

1989 EXPLORATION BUDGET SUMMARY

SCHEDULE 7

1. Exploration Costs	US $(000)
Seismic Acquisition	1000
Seismic Processing	200
Seismic Reprocessing	50
Geological Studies	100
Manpower	695
Computing	120
Other Direct Charges	25
Total Exploration	2190
2. General and Administrative Costs	
Local Office	30
Licence Rental	46
Training	50
Annual Overhead Charge	116
Total General and Administrative	242
TOTAL 1989 BUDGET	2432

NOTES TO 1989 EXPLORATION BUDGET

SCHEDULE 8

1. Seismic Acquisition and Processing

The 2000 km commitment seismic survey is anticipated to commence within 6-9 months of the effective date of the licence. The data will be processed using UK-based contractors.

2. Seismic Reprocessing

It is anticipated that the results of the 1988 reprocessing trials will justify further reprocessing. Budget provision is therefore made for reprocessing approximately 500 km of existing data.

3. Geological Studies

Paleontological, sedimentological and geochemical studies of relevant well data will be undertaken as appropriate to enhance the exploration evaluation of the concession.

4. Manpower

Exploration staff in London will carry out evaluation studies, with support from financial and legal staff. Estimated manpower requirements are:-

	Man Months
Exploration	24
Draughting	4
Legal	1
Finance	2

5. Computing

Associated with digitising, databasing, mapping etc.

6. Direct Charges

Primarily associated with travelling, but including data storage, drawing office reprographics etc.

7. Local Office

LASMO will continue to employ a local representative and accounting firm to manage the Joint Venture affairs. These costs are allocated to local office costs.

8. Annual Overhead Charge

Calculated according to article 2.5 (b), Annex E of the Petroleum Agreement.

GUYANA (SATIRA)

EXPLORATORY ADVISORY COMMITTEE MEETING NO.2

JUNE 2ND, 1989

GEORGETOWN, GUYANA

INTRODUCTION

The second meeting of the Guyana (Satira) Exploratory Advisory Committee Meeting was held on Friday, June 2nd, 1989 at the Guyana Natural Resources Agency. This meeting was divided into two parts. The first part was a technical presentation by LASMO to the Technical staff of the Petroleum Unit and the second was a discussion of Policy issues and related matters between LASMO and GNRA.

TECHNICAL PRESENTATION

Present were:-

Mr Steve Mills - LASMO - Manager, New Ventures
Mr Brian Hodgson - LASMO - Manager, Guyana Project
Mr Andrew Seetram - GNRA - Petroleum Engineer
Mr Mitchell Prince - GNRA - Petroleum Technologist
Mr Christopher Lynch - GNRA - Technician Engineer

The following is a summary of the salient points of the technical presentation:

The work programme as presented at the first Guyana Exploratory Advisory Committee meeting (Nov. 1988) was progressing as scheduled.

2. Geological and geophysical work was progressing satisfactorily.

3. Work has started on the reinterpretation and correlation of well data for all wells drilled offshore Guyana. So far, the Mahaica and Essequibo wells have been completed and the Berbice wells commenced.

4. LASMO has commenced basin modelling studies and will probably use a kinetic modelling approach.

5. LASMO has commenced regional studies which will assist with Cretaceous plate movement reconstruction, the compilation of type Cretaceous columns along the margin and the production of palaeogeographic maps.

6. LASMO has successfully completed trial processing of several lines from the Seagull Denison 1981 survey and is proceeding with the reprocessing of approximately 2000 km of data from the 1981/82 surveys. LASMO wished to include Shell's 1971 data but could not obtain these from Shell.

7. Time structure mapping of the Miocene, Eocene and Top Albian Carbonates has been completed using the old available data.

8. The 1989 seismic acquisition programme which involves shooting of 38 lines totalling over 3,000 km has begun. Processing is expected to take about three months and because of the quantity of data involved more than one contractor will be used during processing trials. With these new data LASMO will continue the mapping of the Satira Block.

DISCUSSION OF POLICY ISSUES AND RELATED MATTERS

Present were:

Mr Winston King - GNRA - Executive Chairman
Dr Barton Scotland - GNRA - Deputy Chairman
Mr Andrew Seetram - GNRA - Petroleum Engineer
Mr Stephen Mills - LASMO - Manager, New Ventures
Mr Brian Hodgson - LASMO - Manager, Guyana Project

Following is summary of the salient issues discussed.

1. Article 15.2

Mr King informed LASMO that the Commissioner of Inland Revenue had approved the amendment of Article 15.2 of the Agreement to cover affiliated companies and that Jeanne-Marie de Larrazabal and Martin Scott would soon be apprised of this development.

2. '89 Seismic Programme

Mr King said that he had been approached by Mr John Elliot of Petrel to discuss with LASMO the possibility of including an additional 350 line km in LASMO's current seismic programme. Some of these lines would simply be extensions of LASMO's lines north of the concession and could be shot concurrently with LASMO's programme. The remaining additional lines would be to the south of the concession and could be shot after LASMO's programme was completed. These additional lines would not extend LASMO's programme by more than one week and would be at no additional cost to LASMO. Mr King asked LASMO to explain their position on this matter.

Mr Hodgson replied that LASMO was given late notice of Mr Elliot's plan and preferred not to modify their programme at such a late stage. He indicated that LASMO would like to complete the programme as soon as possible and any additional work would not only extend their programme but would further expose the survey to possible mishap. He added that LASMO had no objection to Mr Elliot's programme per se but preferred that it be carried out independent of LASMO's.

Mr King said that he understood LASMO's position and would convey this to Mr Elliot.

3. JOA - LASMO/BHP

Mr King enquired about the status of the JOA between LASMO and BHP. Mr Mills admitted that all the details of the JOA had not been fully worked out, but stated that agreement on outstanding points was anticipated shortly.

Enquiring about the nature of JOA's in the petroleum industry, Mr King speculated about the possibility of a non-operating partner seeking additional information about the contract area without the knowledge of the operator and asked whether such a situation would be considered normal in the Petroleum Industry.

Mr Mills said he would consider such a situation to be very unusual. He added that at this stage of exploration having the JOA not finalised was not a problem. It would become a problem when the time came to drill a well as the JOA dictates how the cost would be split.

4. Surinamese Data

Mr Hodgson asked whether GNRA had made a decision as to the inclusion of the cost of Surinamese data from outside of the Satira Block in the cost recovery pool.

Mr King responded that GNRA was still considering this request and was looking for a precedent before making a decision, as the contract only made provision for cost recovery from data within the contract area.

5. Guyana/Suriname Border Problem

Mr Hodgson enquired about the current position of the Guyana/Suriname border problem.

Mr King replied that he had recently spoken to the Minister of Foreign Affairs who informed him that discussions were still continuing towards a resolution of the matter. A committee comprising officials from both governments was being set up to look into areas of bilateral cooperation. This committee (of which the Deputy Chairman, GNRA would be a member) would have the border problem as a priority and would be looking at practical ways to facilitate settlement.

Mr Mills said that he was glad to hear that a practical approach was being adopted and asked about the time frame that such an approach would entail.

Mr King responded that it would be difficult to pin down a time frame as such matters generally took some time. He was, however, optimistic about an early settlement.

6. Shell's 1971 Seismic Data

Mr Hodgson stated that he had tried unsuccessfully to obtain Shell's 1971 data and asked whether GNRA could further pursue this issue as these data would be very helpful in the mapping of the concession.

Mr Seetram said that the Petroleum Unit had on at least two occasions tried to obtain these data from Shell but were unsuccessful.

Mr King then suggested that GNRA could try approaching Shell through their downstream local representative to pursue the data.

7. Petrel Charges

Mr Hodgson expressed disappointment at GNRA not agreeing to include the US $150,000 signing bonus to Petrel in the post contract cost recovery pool, but obviously accepted the GNRA's decision on this matter.

Mr King maintained GNRA's position that this issue was settled during contract negotiations where it was agreed that this item would be included in precontract costs. There should therefore, he added, be no need to further discuss it.

8. '88/'89 Budget

LASMO stated that the projected expenditure for 1988/89 was broadly in line with the 1988/89 Budget.

9. Other Matter

Mr Hodgson, stating that LASMO had not received a copy of GNRA's minutes of the first Exploratory Advisory Committee Meeting, handed over a copy of LASMO's minutes to Mr King.

Mr King expressed surprise at this and promised to look into it.

The meeting concluded with Mr King wishing LASMO continued success in their operations and hoping that the Satira Block would be another of LASMO's successful exploration efforts.

GUYANA NATURAL RESOURCES AGENCY,
PETROLEUM UNIT

July 19th, 1989

GUYANA NATURAL RESOURCES AGENCY

PETROLEUM UNIT

REPORT ON THE SEISMIC SURVEY BY WESTERN GEOPHYSICAL FOR LONDON AND SCOTTISH MARINE OIL AND BROKEN HILL PROPRIETARY, COMPLETED DURING MAY 29 TO JULY 8, 1989

PREPARED FOR : MR. BRIAN SUCRE
DIRECTOR, PETROLEUM UNIT

1989-08-01

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PARTY 91 - CREW LIST

PERRY CONE	-	COORDINATOR
JIM SCOTT	-	ASSISTANT COORDINATOR
TOBY DAWSON	-	OBSERVER
TIM COLSON	-	OBSERVER
GARTH STUHR	-	OBSERVER
JIM KEATON	-	CHIEF GUNNER
DARYL DOTY	-	GUNNER
SCOTT HICKMAN	-	GUNNER (SHIFT LEADER)
WILL JOHNSON	-	GUNNER
TOM GOBLE	-	NAVIGATOR
MATTHEW MEED	-	NAVIGATOR
ED VIROSTKO	-	TECHNICIAN
GLEN BARKER	-	ENGINEER (GUNS)
BOB BRINDLE	-	CONSULTANT (SOUTHERN GEOPHYSICAL CONSULTANTS)
C.S. MONYHAN	-	COMPANY REPRESENTATIVE
MIKE STRAIN	-	PARTY MANAGER
FERNANDO CORREIA	-	PARTY LOGISTICS

INTRODUCTION

London and Scottish Marine Oil and Broken Hill Proprietary (LASMO/BHP) have fulfilled part of their contract to the Guyana Government. LASMO/BHP employed Western Geophysical Company to perform a marine geophysical survey throughout their offshore concession.

The survey commenced on May 29 1989, and was completed July 8, 1989. During this time, approximately three thousand, two hundred and eighty five (3,285) line kilometres of two (2) dimensional seismic data was recorded in 'array' form.

Some problems occured during production of the data. These included systems malfunctions, rough seas and marine traffic. At all times, personnel for the Western Anchorage and Party 91, the vessel and persons assigned to the mission, worked diligently to keep production on stream so as to complete the job at the earliest time.

Ai PROGRAMME OUTLINE

All production lines were numbered following the convention given below :

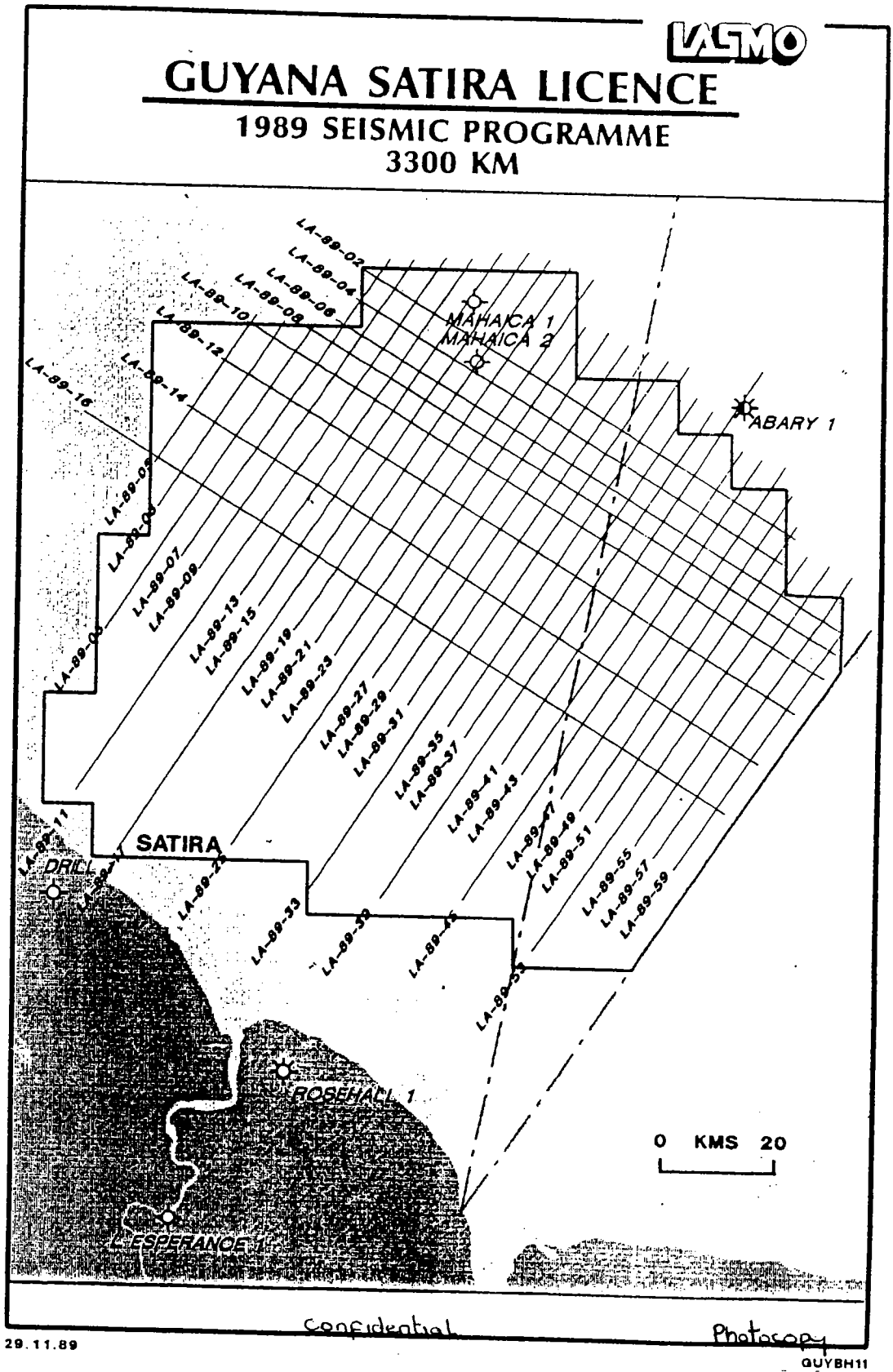
LA - LASMO 89 - year of survey

01 - line numbers

There were two sets of lines. Odd numbered lines in a 034° direction, and even numbered lines in a 121° direction (See figure 1). Eight lines in the 034° direction extended as close to the coast line as possible. Table I, which lists the line numbers, their time commenced and completed have the inshore lines denoted by an asterisk(*).

Aii NAVIGATION

The Argo and Syledis Systems were the two navigational systems used. Both were radio systems and base stations for them were fabricated at Dunkeld on the Essequibo Coast, Clonbrook and Paradise on the East Coast of Demerara and Adventure on the Corentyne Coast.



Oil Concessions
(Guyana)

TABLE I

All times are G.M.T.

Lines bearing 034°	Commenced	Completed
01	June 10 14:02	June 10 20:04
03	June 15 00:47	June 15 09:44
*05	June 10 22:32	June 11 05:35
07	June 15 12:55	June 19 07:59
09	June 16 02:32	June 16 22:06
*11	June 17 09:57	June 25 00:24
13	June 18 09:03	June 18 20:46
15	June 19 11:19	June 19 19:29
*17	June 21 20:09	June 28 02:57
19	June 20 22:08	June 28 17:47
21	June 24 08:22	June 27 23:32
23	June 25 05:58	June 29 02:58
*25	June 25 13:43	June 28 22:29
27	June 26 08:35	July 02 16:07
29	July 02 02:17	July 02 10:23
31	July 02 18:25	July 03 04:34
*33	June 29 06:30	June 30 18:32
35	July 03 20:21	July 04 04:38
37	July 01 13:15	July 01 23:19
*39	June 30 20:40	July 01 09:57
41	July 03 07:18	July 03 16:09
43	July 04 06:51	July 04 16:38
*45	July 04 18:13	July 05 18:28

47	July 06	14:28	July 07	04:12
49	July 05	06:22	July 07	14:58
51	July 06	06:33	July 06	13:04
*53	June 13	04:30	June 13	13:55
55	June 13	16:37	July 06	04:56
57	June 12	20:13	June 12	02:40
59	June 12	10:37	June 12	16:28

* denotes lines run into shore as closely as conditions allowed.

Lines Bearing 121°	Commenced		Completed	
02	July 07	18:55	July 08	04:06
04	June 14	14:10	June 14	23:25
06	June 12	02:18	June 12	08:44
08	June 08	05:17	June 09	00:19
10	June 05	20:30	June 07	10:47
12	June 05	03:44	June 08	02:57
14	June 02	19:00	June 04	04:47
16	June 04	07:07	June 04	20:53

The precise coordinates for the base stations were determined by satellite. The Argo system, which is accurate over greater distances, was calibrated by the Syledis system which was more accurate over smaller distances. Appendix i gives a brief explanation of how navigation was accomplished using these systems.

Aiii ENERGY SOURCE

The energy source for this operation was a new system of thirty-two (32) air guns providing a total capacity of three thousand (3,000) cu. ins. The guns were divided into four (4) strings. On each string they were either arranged individually or in clusters. With only two thousand and forty (2,040) cu. ins. required, limited substitution of one gun for another was possible if a malfunction occurred.

The guns were fired simultaneously every twenty-seven (27) metres. Synchronization was achieved with the use of a 'Litton Resources System' gun controller. The guns were not allowed to be out of synchronization by more than two (2) milliseconds. Appendix ii briefly describes certain aspects of the gun system.

Aiv RECORDING SYSTEM

The recording system was a digital streamer four thousand (4,000) metres in length, with three hundred (300) channels formed into one hundred and fifty (150) arrays. The streamer was kept at a given depth by electronically controlled devices called 'birds', monitored and activated from within the instrument room. Reflected sound waves from the source were detected by sensors located every two (2) metres along the cable. Amplified, the responses were recorded on magnetic tape in 'array' form. Some specifics of the streamer are in Appendix iii.

Av OPERATIONS CONTROL

The instrument room was the centre of control. T.V. monitors displayed streamer status, noise conditions and gun status. A 'line scan recorder' continuously gave traces of the seismic record. During production, a 'raw harmonic distortion analysis' was performed. The analysis indicated whether receptive channels were functioning properly. Allowed distortion was set at 0.1%.

Observers in the instrument room logged any errors that arose. These errors were usually 'missfires' or 'shortfiles'. Other types of errors did occur and some are given in Appendix iv.

Television monitors present both on the Captain's bridge and the instrument room continuously updated the Julian day of the year, time of day, distance and velocity off or on line, the bearing, water depth, latitude and longitude among other systems' information.

A 'Geoscience Data Unit'capable of determining whether systems' information was being received by systems' components was in operation. A close check on these systems was kept by members of Party 91. At all times two (2) observers, a navigator and two (2) gunners were on duty. A technician and engineer were on call when not on duty as was the coordinator or assistant coordinator.

Avi WEATHER

The weather was fair throughout the entire survey. Tides ranged from three (3) to seven (7) feet with moderate winds. There were periods during which conditions were less desirable for production leading to some problems.

Avii PROBLEMS ENCOUNTERED

Fishing Vessels :

Fishing vessels were present in the survey area for most of the time. On occasion, approaching vessels were warned off by shortwave radio and flares. Vessels in the Demerara region displayed more courtesy than those in the Berbice region.

In the Berbice region, there were instances where vessels crossed the cable and maneouvred themselves in an erratic fashion, totally ignoring radio warnings, flares and ultimately megaphones. Most vessels observed were in need of paint and their names were obliterated beyond recognition even at the relatively close distances of the encounters.

Navigation :

The navigation system malfunctioned on a few occasions. The Argo receiving antenna was put out of commission because of a burnt loading coil which leaked signals to 'earth'. A spare antenna was available and erected.

Signals from one or other of the base stations were not always well received. This was probably related to the location of the vessel.

On more than one occasion, the loss of 'clean' power which runs all of the monitoring systems, affected the navigation system. These problems were all quickly diagnosed and solved.

Streamer :

Production of seismic lines was interrupted by imbalance, leaks and leakage developed in the streamer. The streamer had to be rolled in for investigation.

Guns :

Initially, the guns functioned in an unreliable fashion. As diagnosis of their problems became more accurate and an ample supply of spares became available, a greater degree of consistency was achieved.

Sea Conditions :

On numerous occasions, production had to be stopped because of increasing 'swell' noise and strong currents running parallel to shore, causing unacceptable feather angles to develop. This problem was a major concern while shooting lines on 034° where feather angles greater than fifteen (15) degrees developed.

A viii OTHER PHENOMENON

A continuous log of the depth to sea bottom was run as the vessel traversed the prospect. At random intervals, sea bottom features, probably sand banks, were observed. These features reached heights of thirty (30) feet in about two hundred (200) feet, causing some concern in shallow waters.

Of great puzzlement was a high frequency, intermittent signal and a similar lower frequency signal from an indeterminate source. The signals were staggered and became stronger as the Demerara coast was approached. Fortunately, none of these occurrences affected the rate of production or quality of the data acquired.

Aix

CONCLUSIONS/RECOMMENDATIONS

1. The seismic operations should be given ample publicity. This would reduce the number of confrontations between the seismic vessel and other sea vessels.

2. New gun systems should be given extensive tests for operational reliability. This would save much time during contracted operations.

3. Seismic operators should review naval atlases which indicate sea and weather conditions for the different times of the year. This would help clients to set realistic parameters for operators.

4. Attempts should be made to discover the source(s) of the foreign, non-random noises - their frequencies wavelengths and times of operation should be made available to the seismic operators.

5. Despite the sometimes perplexing circumstances, the contract to acquire three thousand, three hundred (3,300) line kilometres of offshore seismic data, was in my estimation, accomplished in a satisfactory manner.

PREPARED BY : NEWELL DENNISON
GEOLOGIST

APPENDIX I

NAVIGATION SYSTEMS

The Argo and Syledis radio navigation systems used four (4) base stations from which a combination of three (3) provided a three (3) way fix by triangulation. The precise coordinates for the base stations were determined by Satellite. Signals emanating from the stations at a fixed frequency and wavelength were received by the ship. The exact number of half wavelengths the ship was distant from each station was displayed digitally. Using the known wavelength, the distance from each base station was computed. A fix for the vessel was then determined by triangulation. The vessel's position, cable offsets in graphic display, and 'shot point' locations, were computed by the vessel's 'Wisdom' computer system.

APPENDIX II

GUNS

The guns were a new system operated as a 'tuned array'. In each of the four (4) strings, guns of various sizes were individually strung or attached in clusters of two (2). They were matched or 'tuned' so that there would be a low 'noise' level associated with the principle signal. There is an explanation for this outcome.

When larger capacity guns are fired, bubbles expand to the surface creating secondary undesirable signals (noise). It is the same when smaller guns are fired. In a 'tuned array' bubbles/waves sourced by a larger gun in the cluster suffers interference by bubbles/waves sourced by a smaller matched gun. This interference considerably reduces 'noise'.

The new system has its advantages :

(a) A distinct signal was produced by an array.

(b) A useful signal was produced from an array even during a missfire event.

It also has its disadvantages. In order to reduce bulk and drag, each gun was not serviced by its own 'air hose'. When a gun malfunctioned, it could not always be shutdown without having a complimentary effect. This sometimes resulted in the decrease of the total volume below the limit required to give a proper signal. Production has to be stopped for servicing of the gun.

GUN MECHANICS

The mechanics of the gun's operating system is relatively complex. The attached figure 2 shows a typical gun.

APPENDIX IV

ERRORS

Some errors are listed below with explanations where possible.

a. Seismic Quality Control Error :

An error that can result from the malfunctioning of a channel.

b. Missfire :

An error resulting from the missfiring of a gun or cluster of guns.

c. Short File :

This occurs when the 'array' data is being recorded near the end of a tape where there is insufficient space left to accommodate the complete file. Another tape reel is started immediately but the occurrence is registered.

d. Synchronization Error :

An error resulting from the premature or delayed firing of a gun.

e. Parity Errors :

There are a number of errors (e.g. tape parity error, memory parity error, byte count error and bad record error) that are not easily explained. Some are peculiarities to the systems' software. Others are related to the way in which the 'bulk memory module' functions. The 'bulk memory module' has threshhold values for a selection of errors and registers them as they occur.

The gun has a tapered sleeve (7), with a ridge dividing an upper narrowing chamber from a lower cylindrical chamber. There are narrow vents (V) just beneath the ridge in the cylindrical section. These vents are a pathway from the cavity created when the sleeve is fitted to the body of the gun (1). They are accessed by vents in the terminal section of the valve solenoid (11).

The valve solenoid is spring loaded in the closed position. An electrical pulse activates the solenoid, momentarily opening the spring valve. Air, which is being pumped into the whole assembly continuously via bore (a) in the body of the gun, is forced at that instant through the valve (b) and exits via holes surrounding the main valve bore. These holes are in contact with the lower pressure of the atmosphere by way of the small vents (V) beneath the centrally located ridge of the sleeve. The sudden pressure difference causes the main reservoirs to impart their high pressure upon the cylindrical part of the sleeve, forcing the whole assembly up and exposing the main chambers. The chambers are depleted with a loud pop. By this time, the valve has long since been closed and because the air supply has not been interrupted, pressure building the upper narrowing chamber forces the sleeve assembly back down over the main chamber. The process is continuous.

When the valve is closed, and the electrical, solenoid activating contact is broken, a relay informs the monitoring units that the gun has fired. Timing devices constantly adjust firing so that all guns go off at the same instant.

TABLE 2

DATE	DAILY TOTAL	CUM TOTAL
June 2	29.92	29.92
3	73.17	103.09
4	156.42	259.51
5	49.19	308.70
6	41.12	349.42
7	129.84	479.66
8	133.44	613.10
9	3.31	616.41
10	49.16	665.57
11	127.52	793.09
12	126.75	919.84
13	127.84	1047.68
14	91.79	1139.47
15	88.77	1228.24
16	70.29	1298.53

DATE		DAILY TOTAL	CUM TOTAL
June	17	64.16	1362.69
	18	80.43	1443.12
	19	117.23	1560.35
	20	31.17	1591.52
	21	40.88	1632.40
	22	9.65	1642.05
	23	0.00	1642.05
	24	80.96	1723.01
	25	115.79	1838.80
	26	119.84	1958.64
	27	76.21	2034.85
	28	70.88	2105.73
	29	114.90	2220.63
	30	61.07	2281.70
July	01	149.60	2431.30
	02	130.58	2561.88
	03	159.17	2721.05
	04	152.40	2873.45
	05	88.00	2961.45
	06	183.00	3144.45
	07	99.38	3243.83
	08	40.66	3284.49

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12 October 1989

Memorial of Guyana
Annex 148

Mr W King
Guyana Natural Resources Agency
41 Brickdam and Boyle Place
Stabroek
Georgetown
Guyana
Telex: 3010 GNRA GY

Dear Sir:

We refer to your letter of September 8, 1989. We thank you for your approval of the Minutes of the First Meeting and our comments on the Second Meeting will follow.

We are pleased to learn of the Presidential dialogue with Suriname on the border issue which is a positive step forward.

Are you now able to assure us that in the event of our proceeding to drill a prospect in the "overlap" area, the agreement that "existing arrangements within the area would not be disturbed" means:

i) Suriname will not in any way interfere with such drilling activity; and

ii) Suriname will respect the contract between our companies and Guyana and the rights, benefits obligations and liabilities thereunder will not be varied.

Incidentally, we now understand that the IPEL acreage has been surrendered by that company.

We look forward to welcoming the GNRA delegation to our new offices in London, where we propose to hold the next Exploration Advisory Committee Meeting on Tuesday 28th/Wednesday 29th November. We would be pleased to cover the expenses of up to three/four visiting delegates.

A formal agenda for the meeting will be issued in due course, but topics for discussion will include:

- status of licence evaluation

- work programme and budget for 1990
- Suriname border issue
- JOA summary

We would appreciate an indication that the proposed dates are acceptable, and details of visiting delegates so that appropriate travel and accommodation arrangements can be made.

Yours sincerely,

B.D. Hodgson

B D Hodgson
Manager, Guyana Project

BDH/3089h/dja 12.10.89

ABARY AGREEMENT

THIS AGREEMENT is made in duplicate this 2nd day of October 1989 between the Minister responsible for Energy and Mines (hereinafter referred to as "the Minister") representing the Government of Guyana (hereinafter referred to as "the Government") of the one part.

and

Petrel Petroleum Corporation, a company incorporated in Texas and having its registered office at 2437 Pelham Drive, Houston, Texas, 77019 U.S.A. (hereinafter referred to as "Petrel") of the other part.

WHEREAS:

(i) The Government asserts that the ABARY AREA described in ANNEX A and shown on the map in ANNEX B hereof lies within the territory of Guyana.

(ii) The Minister on behalf of the Government has authority to and responsibility for licencing any petroleum activity in the said Area.

(iii) By letter dated April 30, 1989 (and attachments thereto) and attached hereto as Attachment A Petrel proposed that GNRA enter into discussions with it concerning an "exclusive arrangement" in relation to this Area.

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ABARY AGREEMENT

ANNEX "A"

Description of Area

The following is a description of the **ABARY AREA** as shown in the map in ANNEX "B".

Starting at point "a", Latitude 8° 00' N, Longitude 57° 20' W eastwards
to point "b", Latitude 8° 00' N, Longitude 57° 10' W southwards
to point "c", Latitude 7° 55' N, Longitude 57° 10' W eastwards
to point "d", Latitude 7° 55' N, Longitude 57° 05' W southwards
to point "e", Latitude 7° 50' N, Longitude 57° 05' W eastwards
to point "f", Latitude 7° 50' N, Longitude 57° 00' W southwards
to point "g", Latitude 7° 45' N, Longitude 57° 00' W eastwards
to point "h", Latitude 7° 45' N, Longitude 56° 55' W southwards
to point "i", Latitude 7° 40' N, Longitude 56° 55' W eastwards
to point "j", Latitude 7° 40' N, Longitude 56° 50' W southwards
to point "k", Latitude 7° 35' N, Longitude 56° 50' W eastwards
to point "l", Latitude 7° 35' N, Longitude 56° 40' W southwards
to point "m", Latitude 7° 30' N, Longitude 56° 40' W eastwards
to point "n", Latitude 7° 30' N, Longitude 56° 35' W southwards
to point "o", Latitude 7° 25' N, Longitude 56° 35' W eastwards
to point "p", Latitude 7° 25' N, Longitude 56° 17' W southwesterly
along the Guyana/Suriname border
to point "q", Latitude 7° 00' N, Longitude 56° 32' W westwards
to point "r", Latitude 7° 00' N, Longitude 56° 40' W northwards
to point "s", Latitude 7° 10' N, Longitude 56° 40' W westwards
to point "t", Latitude 7° 10' N, Longitude 56° 45' W northwards
to point "u", Latitude 7° 15' N, Longitude 56° 45' W westwards
to point "v", Latitude 7° 15' N, Longitude 56° 50' W northwards
to point "w", Latitude 7° 20' N, Longitude 56° 50' W westwards
to point "x", Latitude 7° 20' N, Longitude 57° 00' W northwards
to point "y", Latitude 7° 30' N, Longitude 57° 00' W westwards
to point "z", Latitude 7° 30' N, Longitude 57° 20' W northwards
to starting point at "a".

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Comprising the following 5' x 5' graticular blocks.

Q - 9 - 10, 21 - 23, 33 - 36, 45 - 48, 57 - 60, 69 - 72.

R - 37, 49 - 50, 61 - 64, 73 - 77, 85 - 92, 93 (part), 99 - 103, 104 (part), 112 - 114, 115 (part), 125 - 126, 127 (part), 137, 138 (part), 139 (part).

GUYANA NATURAL RESOURCES AGENCY,

October 12, 1989.

ANNEX "B"

Oil Concessions
(Guyana)