85-1,2

FINAL REPORT 1985

ATLANTIC GEOSCIENCE CENTRE

NEWFOUNDLAND DEEP SEISMIC SURVEY

M/V POLAR PRINCE

TABLE OF CONTENTS

D. SOURCE

An areal tuned airgun array of 127.48 L capacity was used to generate seismic energy at a 50 m shotpoint interval. This array, which had a total width of approximately 70 m, consisted of 60 active guns and 12 spare guns with various characteristics towed on six separate strings. Compressed air at an operating pressure of approximately 13.8 MPa was supplied by three LeRoi and three Norwalk Century compressors. A Texas Instruments TIGER II airgun controller fired and timed each gun within the array, offering a phasing standard deviation of within +/- 1 ms.

Airgun array description and diagram are found in Appendices A-7 and A-8.

E. SURVEY

Three navigation systems were calibrated for this prospect--ARGO, Loran-C and SPOT. The crew intended to use the ARGO system for two priority northern lines. However due to extensive ice obstructions these lines were never shot, and ARGO proved to be unuseable for the remainder of the project due to long ranges and poor geometry between base stations. Accordingly satellite fixes combined with Sonar, Loran-C, SPOT and manual velocities provided the navigation information for the rest of the survey.

Two range-to-range navigation systems, Loran-C and SPOT, were operated by CAN-NAV Limited to provide the primary and secondary survey data, and were interfaced to the CMS II integrated satellite/doppler sonar system of the Texas Instruments R-980B computer. All navigation systems were calibrated prior to the start of this survey and were updated with satellite fixes and baseline crossings and extensions.

The SPOT base stations used in this survey were located at:

Sta. Michaud	045 37 46.84 N	060 35 17.41 W
Sta. Cappahayden	046 51 45.99 N	052 56 19.08 W

The Loran-C base stations were located at:

FIRST CHAIN

Sta. Cape Race	046 46 32.20 N	053 10 28.20 W
Sta. Nantucket	041 15 11.90 N	069 58 39.10 W
Sta. Caribou	046 48 27.20 N	067 55 37.70 W

SECOND CHAIN

Sta. Cape Race	046 46 32.20 N	053 10 28.20 W
Sta. Fox Harbour	055 22 35.20 N	055 42 28.40 W
Sta. Angissoq	059 59 17.27 N	045 10 27.47 W

For further details about the navigation systems, refer to Appendix A-9.

III OPERATIONS

The M/V Polar Prince commenced resupplying for this Deep Seismic Survey at the port of St. John's, Newfoundland on 1985 03 15. At 18:30 G.M.T. the vessel departed port for the survey site, calibrating the ARGO navigation system enroute with fix geometry, lane counts and satellite updates. As the vessel continued towards the prospect area crew members tested the DFS V unit and checked the birds, tailbuoy and wiring of the streamer in preparation for its deployment, while others troubleshot the six-string areal airgun array.

The M/V Polar Prince reached the survey site at 05:30 on 03 17, however stormy seas prevented the start of recording operations. Shortly after arrival in this area the crew encountered difficulties in reloading the quality control software of the 990 STS III computer system, and as gales were forecasted for the next few days the crew decided to use this weather downtime to return to St. John's to obtain replacement software.

The vessel was back in the prospect area by 03 18, however the inclement weather conditions prevailed through 03 24. Although no shooting could take place during this time the crew continued troubleshooting and reballasting the streamer as well as testing the airgun array. An improvement in the weather conditions on 03 24 allowed the crew to deploy the six-string airgun array and to establish the subarray separation distances as well as the stern offsets. While these tasks were being carried out the fifth and sixth strings became entangled in paravane wire on 03 25, necessitating repairs to the source before shooting could begin on Line 1.

Once recording started on Line 1 at 18:01 on 03 25, the collection of seismic, gravity and magnetics data proceeded extremely well through the completion of this line at 14:12 on 03 27. After a period of airgun maintenance, shooting resumed on Line 2 at 06:25 on 03 28, but was halted at 12:05 and again at 21:13 on Line 2A due to obstructions and excessive noise levels generated by shipping and fishing traffic. Streamer repairs due to leakage, which was possibly caused by the cable snagging fishing nets in the area, were required on 03 29 before production could resume on Line 2B at 09:29.

Work halted on Line 2B at 04:10 on 03 30 so that the streamer could be reballasted to accommodate changes in the water temperature and currents and to complete maintenance tasks on the airgun array. These tasks were finished at 23:55 and recording resumed on Line 2C. This last line of the survey was finished at 16:14 the next day despite problems caused by drastic changes in water temperature and large swells. The deteriorating weather conditions prevented the crew from retrieving the streamer, so the vessel set a course for the port of St. John's, traveling at a reduced speed until the seas calmed enough on 04 02 to allow retrieval of the cable. The M/V Polar Prince reached St. John's at 13:30 on 04 03.

IV PRODUCTION STATISTICS

Total Kilometres	626.950
Total Hours	469.50
Recording Hours	89.83
Line Change Hours	0.00
Km / Total Hours	1.34
Km / Recording Hours	6.98
Km / Total Days	32.05
Km / Recording Days	167.50

Total Shotpoints	12 539
Pops / Total Hours	26.71
Pops / Recording Hours	139.59
Pops / Total Days	640.97
Pops / Recording Days	3 350.06

IV TIME STATISTICS

Weather Downtime	222.77	47.45 %
Recording	89.83	19.13 %
Travel & Resupplying	59.58	12.69 %
Other	46.27	9.86 %
Navigation Calibration	18.42	3.93 %
Airgun Failure	16.22	3.45 %
Seismic Interference	8.51	1.81 %
Streamer Failure	7.90	1.68 %
TOTAL	469.50 Hours	100.00 %

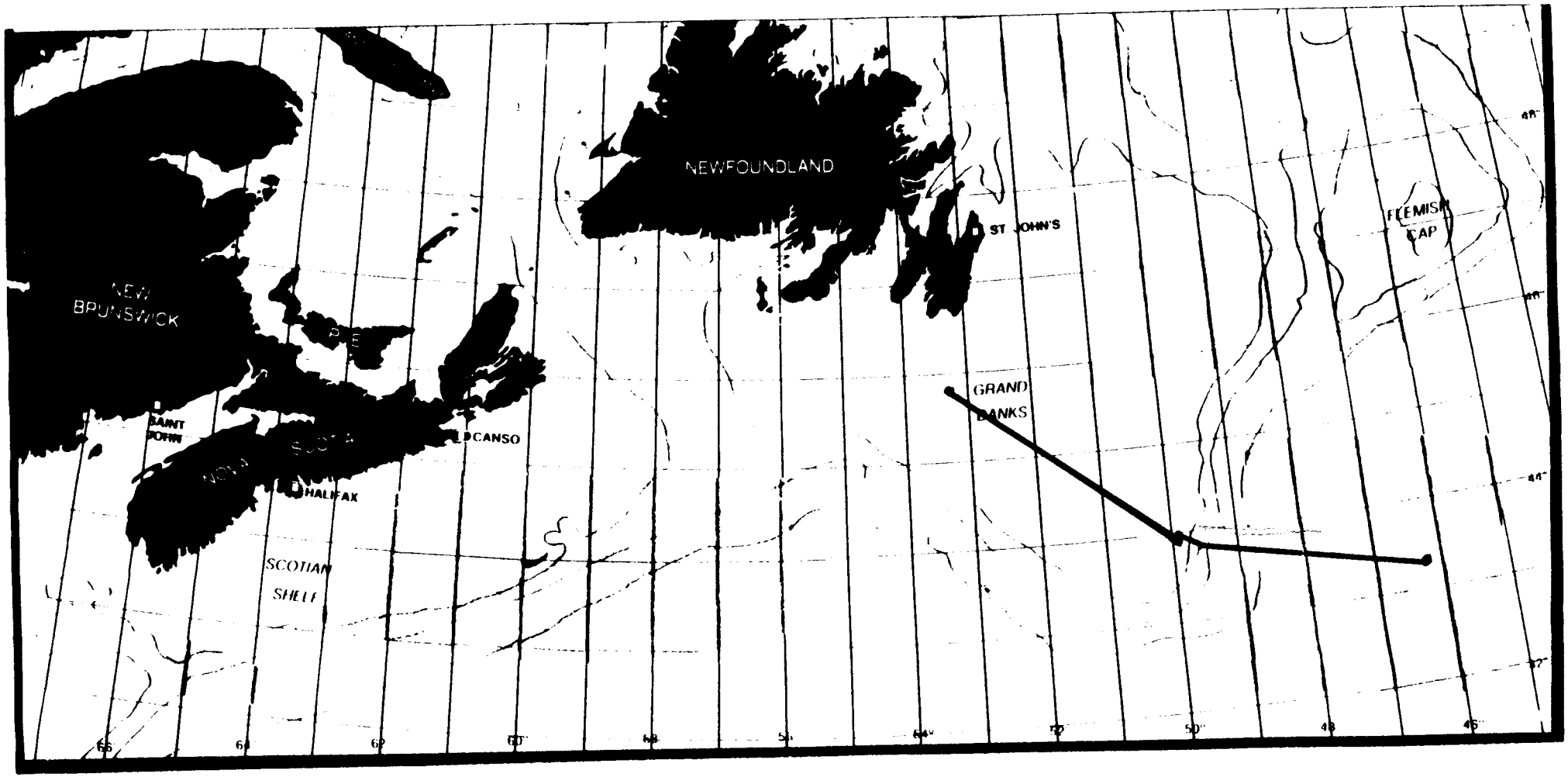
GRAVITY & MAGNETICS DATA COLLECTION

LINE	SHOTPOINT RANGE	TOTAL KM
1	101 - 6649	327.450
2	101 - 861	38.050
2A	983 - 1525	27.450
2B	1728 - 4192	123.250
2C	4395 - 6615	111.050
TOTAL		626.950

TIME & PRODUCTION STATISTICS
ATLANTIC GEOSCIENCE CORPORATION: 1985 NEWFOUNDLAND DEEP SEISMIC SURVEY
M/V POLAR PRINCE
1985 03 15 to 1985 04 03

DATE	LINE	S.P. RANGE	TOTAL SHOTPOINTS	KM	RECORD	LINE CHANGE	TRAVEL/ SUPPLY	STREAMER HANDLING	NAV CALIB	DOWNTIME	TOTAL
03 15							18.50		5.50		24.00
03 16							11.08		12.92		24.00
03 17							5.50			18.50 WX	24.00
03 18										24.00 WX	24.00
03 19										24.00 WX	24.00
03 20										24.00 WX	24.00
03 21										24.00 WX	24.00
03 22										24.00 WX	24.00
03 23										24.00 WX	24.00
03 24										15.50 WX 8.50 OTH	24.00
03 25										18.02 OTH	24.00
	LINE 1	101 - 949	849	42.450	5.98						

DATE	LINE	S.P. RANGE	TOTAL SHOTPOINTS	KM	RECORD	LINE CHANGE	TRAVEL/ SUPPLY	STREAMER HANDLING	NAV CALIB	DOWNTIME	TOTAL
03 26											
	LINE 1	950 - 4516	3567	178.350	24.00						24.00
03 27											
	LINE 1	4517 - 6649	2133	106.650	14.20					9.80 A/G	24.00
03 28											
										6.42 A/G	
	LINE 2	101 - 952	761	38.050	5.67					4.15 S/I	
	LINE 2A	953 - 1687	543	27.150	4.98					2.78 S/I	24.00
03 29											
										1.58 S/I 7.90 STRF	
	LINE 2B	1688 - 3741	2014	100.700	14.52						24.00
03 30											
	LINE 2B	3742 - 4354	451	22.550	4.17					19.75 OTH	
	LINE 2C	4355 - 4366	0	0.000	0.08						24.00
03 31											
	LINE 2C	4367 - 6735	2221	111.050	16.23					7.77 WX	24.00
04 01										24.00 WX	24.00
04 02										13.00 WX	
							11.00				24.00
04 03											
							13.50				13.50
TOTAL			12539	626.950	89.83		59.58		18.42	301.67	469.50



ATLANTIC GEOSCIENCE CENTRE: NEWFOUNDLAND DEEP SEISMIC SURVEY (1985)

Geophysical Service Inc. wishes to take this opportunity to thank the Atlantic Geoscience Centre for its cooperation in the conduct of this survey.

Respectfully submitted,

John W. Clink
Arctic Marine Exploration Manager

JWC/kjb

APPENDIX A-1

M/V POLAR PRINCE

I VESSEL

Owner	Carino Company Ltd.
Year Built	1974
Shipyard	Gregsons, Blyth & Clelands
Country of Registry	Canada
Registration Number	362252
Classification	Ice Class 1, Lloyd's 100A1
Home Port	St. John's, Newfoundland
Trade	Research
Tonnage -- Gross	4180 cu m (1476.35 tons)
-- Registered	1532 cu m (541.25 tons)
Length	76.5 m
Beam	12.8 m
Draught	5.5 m
Type of Vessel	Seismic Research Vessel
Engines	2 - Mirrlees Ser II 6 Cylinder each 1800 HP
Power	2.68 MW
Speed	7.72 m/s (15 knots)
Endurance	60 days
Accommodation	43

II AUXILIARY EQUIPMENT

Generators (AC)	2 - Lister Blackstone, each 270 kW
	Shaft Alternator, 720 kW

III NAVIGATION EQUIPMENT

Radio Equipment	ITT High Frequency Telegraph System
	VHF: ITT STR 65
	Sea Voice RT100
	SSB: Sailor
Call Sign	VY4004
Gyrocompass	Anschultz IV
Auto Pilot	Anschultz
Radar	2 Decca
Fathometer	2 ELAC
Loran	2 Kodan LR735
	TI Loran

IV SEISMIC EQUIPMENT

Control System	CMS II *
Recording System	DFS V **
Streamer	120 trace - universal length
Airgun Array	Up to 127.49 L
	Mod I & Mod II
Compressors	Three: Norwalk Century 600
	Three: LeRoi 750

V SAFETY EQUIPMENT

Fire Containment	Foam Deluge and Auxilary Pump System
	Engine Room CO_2
	Smoke Diving Equipment
	Firesuits
	Extinguishers
Flotation	Life Rings
	Life/Work Vests & Survival Suits
	Life Jackets with Lights & Whistles
	Runabout with Engine
	Life Rafts
Signal	Life Raft Emergency Radio
	Pyrotechnics (distress signals)
	Aldis Signal Lamp
General	First Aid Equipment
	Line Thrower
	Lifeline Tether Harnesses
	Smoke Alarms
	Resuscitator

* GSI Trademark

APPENDIX A-2

CREW DESCRIPTION

SHORE-BASED PERSONNEL

1	Operations Supervisor
1	Senior Administrator

ON-BOARD SEISMIC PERSONNEL

2	Party Managers
2	CMS Operators
4	DFS V Operators
2	Quality Control Coordinators
2	Compressor Mechanics
5	Airgun Mechanics
3	Survey Operators (CAN-NAV Limited)

VESSEL CREW

1	Ship's Captain
2	Mates

APPENDIX A-3

PERSONNEL

Operations Supervisor	M. Kimball	(CDN)
Senior Administrator	F. Cholette	(CDN)
Party Managers	J. Hennessey	(CDN)
	E. Clow	(CDN)
CMS Operators	D. Accardo	(CDN)
	M. Teal	(CDN)
DFS V Operators	J. Kent	(CDN)
	R. Burgoyne	(CDN)
	G. Tapper	(CDN)
	J. Cleveland	(CDN)
Quality Control Coordinators	P. Downey	(CDN)
	K. O'Gorman	(CDN)
Compressor Mechanics	B. Ryan	(CDN)
	S. Brennan	(CDN)
Airgun Mechanics	J. Churchill	(CDN)
	E. Gaulton	(CDN)
	N. Mills	(CDN)
	P. Murphy	(CDN)
	D. MacDonald	(CDN)
Survey Operators:		
CAN-NAV Limited	D. Young	(CDN)
	G. Ryan	(CDN)
	B. Duffy	(USA)

VESSEL

Captain	J. Gurney	(CDN)
Mates	W. Spurrel	(CDN)
	P. Vokey	(CDN)

APPENDIX A-4

INSTRUMENT DETAILS

Recording System	
Type	DFS V*
Serial No.	690
Transports	
Make & Model	DFS V*, EPT 10
Number in use	2
Number of tracks	9
Format	
Type	SEG-B Gapped (phase encoded)
Packing Density	1600 bpi
Tape Speed	49.06 ips
Recording System	1 System/Nears and Fars
Sample Period	4 ms
Record Length	20 s
Gain Control Mode	IFP
Gain Constant	24 dB
Total System Gain	108 dB
Dynamic Range	$\geq$ 84 dB
Reproduce Mode	PGC (variable rate)
Filters	Hi-Cut: 64 Hz @ 72 dB/oct Lo-Cut: 5.3 Hz @ 18 dB/oct
Camera	SIE ERC 10C
Polarity	
Camera	Negative/Downbreaks
Tape	Negative

* TI Trademark

APPENDIX A-5

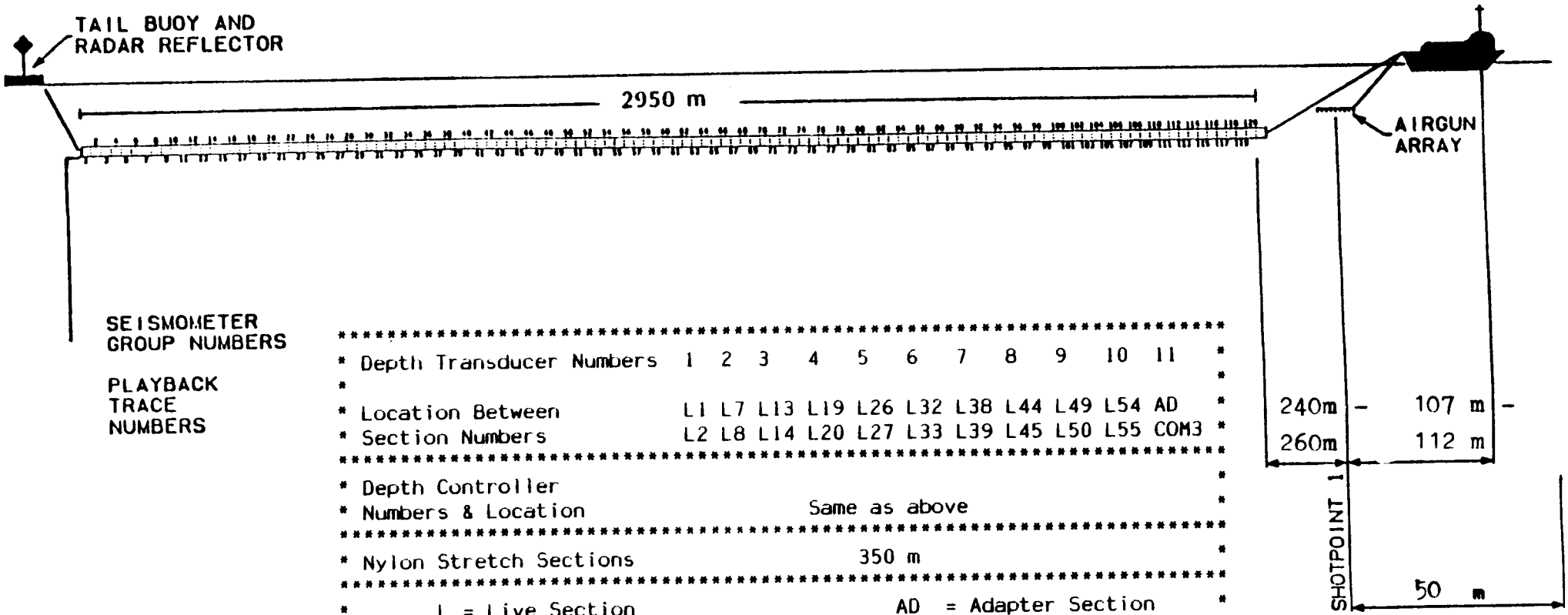
STREAMER DETAILS

Type	Texas Instruments PVC, Neutral Buoyancy, Continuous Tow
Length (Center to Center)	3018 m
Number of Groups	120
Group Length	25 m
Number of Extender Sections	N/A
Extender Section Length	N/A
Number of Live Sections	60
Live Section Length	50 m
Number of Hydrophones / Group	27
Hydrophone Interval	0.93 m
Depth Transducer Length	4.0 m
Compass Section Length	3.0 m
Adapter Section Length	1.0 m
Stretch Section Length	50 m
Total Length of Nylon Stretch Sections	350 m
Stretch Factor	10 %
Average Cable Depth	15 m - 20 m
Locations of Depth Transducers	See cable diagram
Location of Depth Controllers	See cable diagram
Type of Depth Controllers	Remote Controlled Syntron Birds (RCL-2)
Location & Details of Auxiliary Sections (if used)	See cable diagram

APPENDIX A-6

DIAGRAM of 3000 m STREAMER

120 Traces



SEISMOMETER GROUP NUMBERS

PLAYBACK TRACE NUMBERS

Depth Transducer Numbers	1	2	3	4	5	6	7	8	9	10	11	
Location Between	L1	L7	L13	L19	L26	L32	L38	L44	L49	L54	AD	
Section Numbers	L2	L8	L14	L20	L27	L33	L39	L45	L50	L55	COM3	
Depth Controller Numbers & Location	Same as above											
Nylon Stretch Sections	350 m											

L = Live Section
S = Stretch Section
AD = Adapter Section
COM = Compass Section

APPENDIX A-7

AIRGUN DESCRIPTION

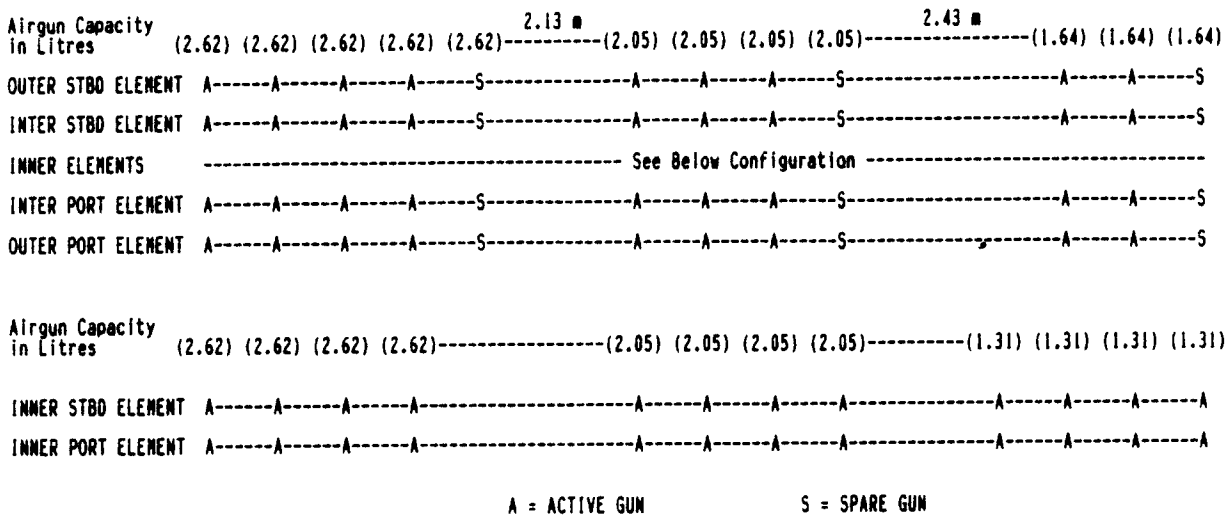
Type	Six String Areal Tuned Array
Total Volume in Use	127.48 L
Total Spare Volume	25.24 L
Timing Controller	
Type	TIGER II*
Serial No.	03
Firing Delay	51.2 ms
Operating Pressure	13.8 MPa
Compressors	
Type	LeRoi 750
No. in Use	Three
Type	Norwalk Century 600
No. in Use	Three
Operating Depth	12 m
Total Array Width	80 m
Length of each String	9.37 m
Distance from Stern to First Gun	
Inner Strings	70.0 m
Intermediate & Outer Strings	75.0 m
Distance from Stern to Array Centre	
Inner Strings	74.7 m
Intermediate & Outer Strings	79.7 m
Distance from Common Navigation Position to Array Centre	
Inner Strings	107.2 m
Intermediate & Outer Strings	112.2 m
Distance from Array Centre to Near Group Centre (OFFSET)	240 m - 260 m

* GSI Trademark

APPENDIX A-8

GSI WIDE TUNED AIRGUN ARRAY

127.48 Litres



A = ACTIVE GUN S = SPARE GUN

AIRGUN ARRAY COMPOSITION

Active Guns:	24 x 2.62 L		Spare Guns:	4 x 2.62 L
	20 x 2.05 L			4 x 2.05 L
	8 x 1.64 L			4 x 1.64 L
	8 x 1.31 L			
Total	127.48 L		Total	25.24 L

NOTES

1. Guns are Texas Instruments Mk II and Mk III PnuCon Airguns.
2. Airgun array consists of two inner elements towed directly behind the boat, and four intermediate and outer elements towed from booms. The six elements have a combined width of approximately 70 m.
3. The length of each element's string is 9.37 m long.
4. Centerline-to-centerline of all coalesced guns is 0.53 m. The first gun of the inner elements is located 70 m from the stern of the vessel, while the first gun of intermediate and outer elements is 75 m from the stern.

APPENDIX A-9

SURVEY INFORMATION

PRIMARY SYSTEM

Type	Loran-C
Survey Company	CAN-NAV Limited
Operating Frequency	100 KHz
Lane Width	299.6929 m
Antenna Height (above sea level)	9.7 m
Antenna Location (from stern)	43.5 m
Anatenna Offset from Ship's Centreline	6.9 m
Antenna Distance & Bearing from Common Navigation Position	13.0 m & 32 Degrees

SECONDARY SYSTEM

Type	SPOT
Survey Company	CAN-NAV Limited
Operating Frequency	2 MHz
Lane Width	149.8345 m
Antenna Height (above sea level)	10.3 m
Antenna Location (from stern)	50.6 m
Anatenna Offset from Ship's Centreline	5.9 m
Antenna Distance & Bearing from Common Navigation Position	19.0 m & 342 Degrees

Survey Information cont'd.

Type	Satellite Transit
Receivers	Magnavox MX1107 RS Dual Channel
Survey Company	GSI
Operating Frequencies	150/400 mHz
Antenna Height (above sea level)	19.3 m
Antenna Location (from stern)	32.5 m

ALTERNATE NAVIGATION SYSTEM

Type	ARGO DM-54
Survey Company	CAN-NAV Limited
Operating Frequency	1624 kHz
Lane Width	92.2626 M
Antenna Height (above sea level)	10.0 m
Antenna Location (from stern)	30.1 m
Antenna Offset from Ship's Centreline	3.6 m
Antenna Distance & Bearing from Common Navigation Position	4.4 m & 124 Degrees

Common Navigation Position	Satellite Antenna
Coverage	3000%
Shotpoint Interval	50 m
Auxiliary Equipment	2 track plotters
Primary calibration points used	Three way fixes & baseline crossings. Least square range resection. Satellite updates.

APPENDIX A-10

POST-PLOT PARAMETERS

Ellipsoid	Clarke 1866
Datum	NAD 1927
Projection	Lambert Conformal Conic
North Parallel	49 Degrees North
South Parallel	43 Degrees North
Origin of Latitude	43 Degrees North
Origin of Longitude	51 Degrees West
Map Scale	1: 1 000 000
Position Plotted	Antenna
Shotpoint Plot Interval	100
Shotpoint Label Interval	1000

APPENDIX A-11

FATHOMETER / SINGLE TRACE PROFILER

FATHOMETER

Manufacturer	Simrad
Model	EA
Conversion Velocity	1480 m/s
Operating Frequency	38 kHz
Instrument corrected for draught	4.5 m
Transducer Position	
From Stern	47.0 m
From Common Navigation Position	14.5 m forward of antenna
Fathometer check	March 15, 1985 St. John's, Newfoundland

SINGLE TRACE PROFILER

Manufacturer	EPC Labs Inc.
Model	3210 S
Serial Number	444
Source	Seismic Trace #118
Gain Mode	IFP
Recorder Start	Pseudosod
Display Method	Single Channel Display
Hi Filter and Slope	64 Hz @ 72 dB/oct
Lo Filter and Slope	5.3 Hz @ 18 dB/oct