

9229-B059-003E

1996 SEISMIC PROGRAM REPORT

FORT LARD AREA



1996 Seismic Program Report

9229 - B059 - 003E DA

EL 365, near Fort Liard, N.W.T.

January - March 1996

Contractor: Geco-Prakka

*Supervising Consultants: BFR Geophysical
Consultants Ltd.*

*Operator and 100% Interest Owner: Ocelot
Energy Inc.*

Report Author: Rita Polt

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Figure 2. Interpreted line LR 96-1 over prospect

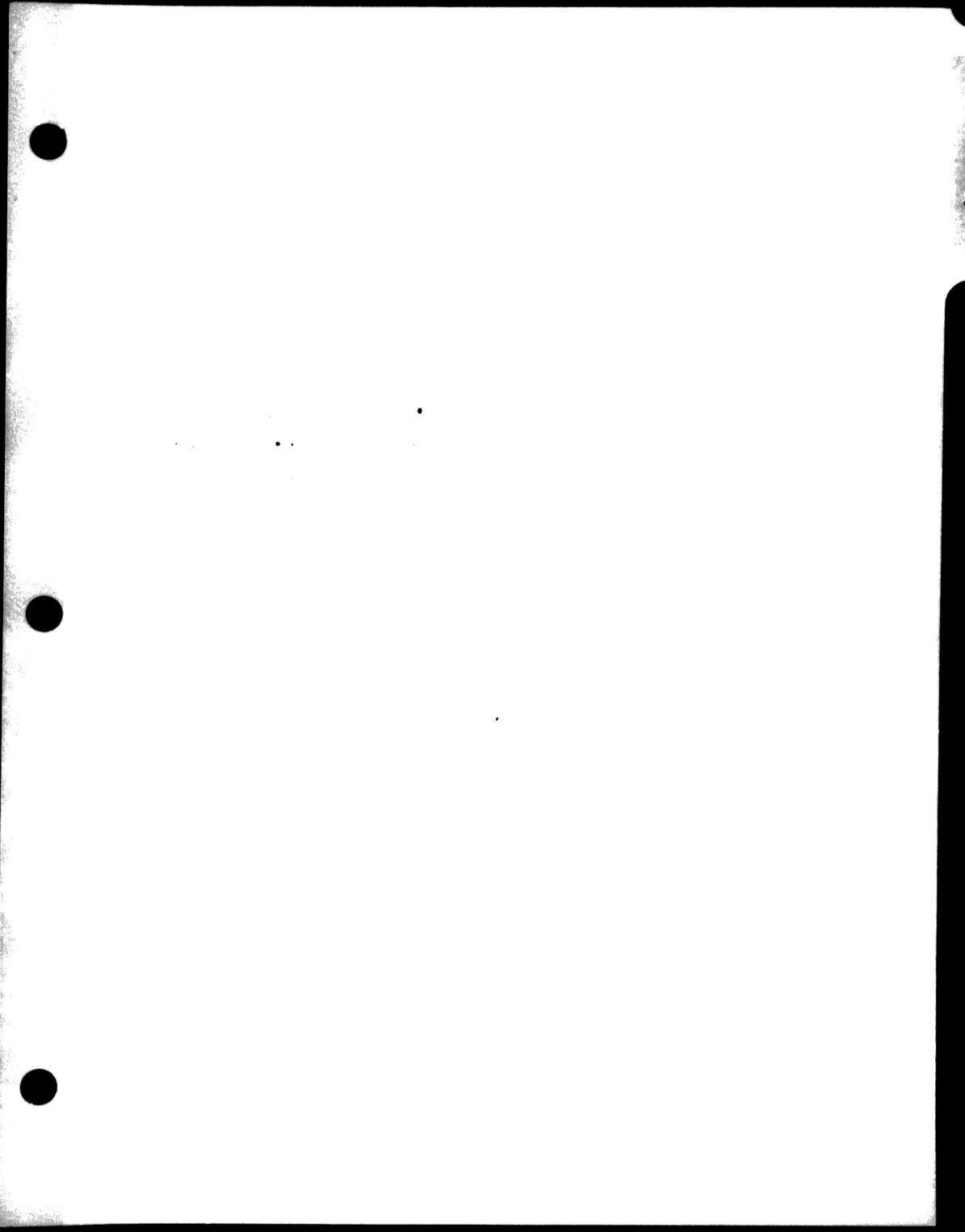
List of Enclosures

- 1. Middle Devonian Time Structure Map**
- 2. Synthetics for East Flett H-13, Nelta M-31, and Arrowhead N-02**

Sent separately to N.E.B. Attention Rudy Klaubert

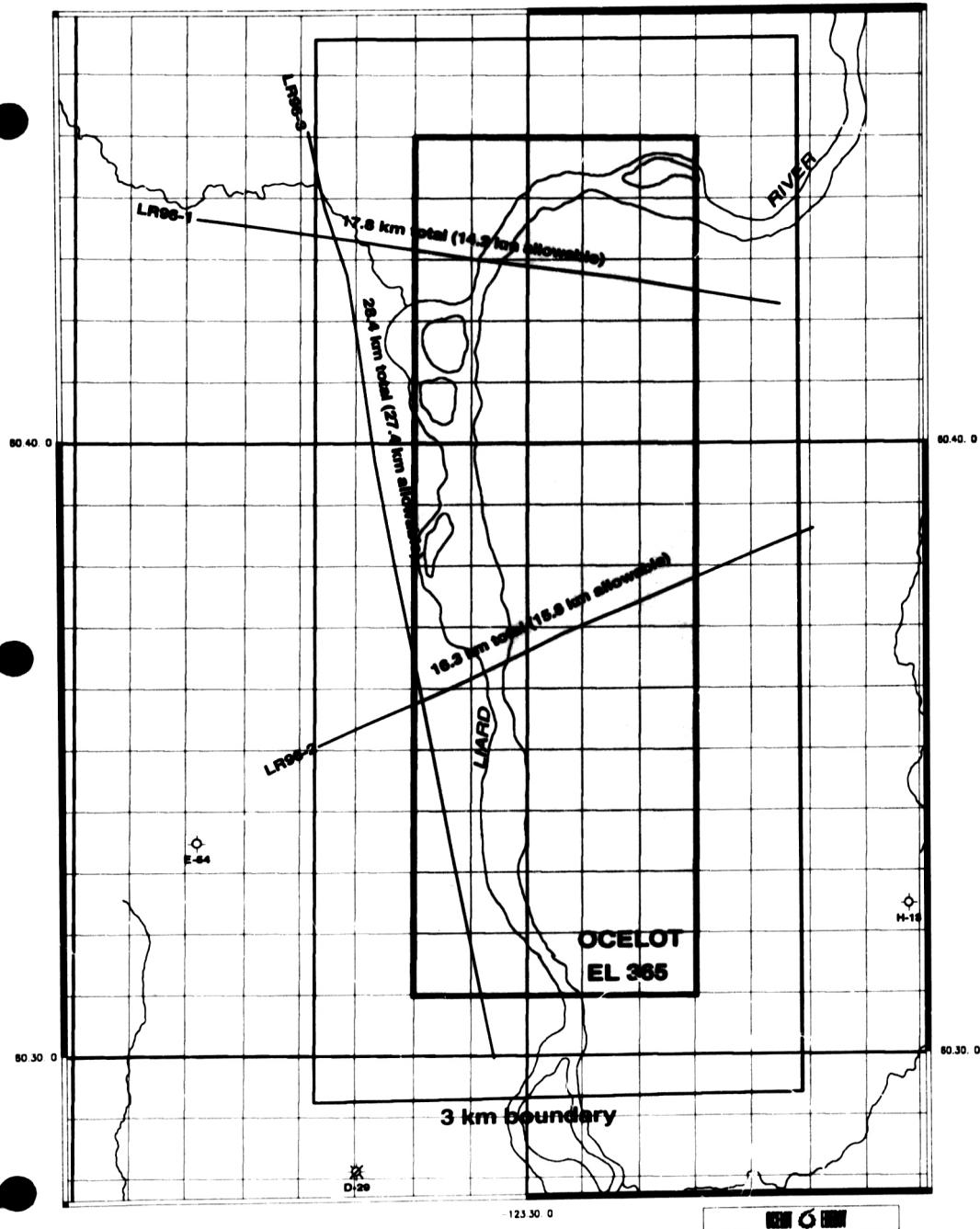
For each of lines LR 96-1, LR 96-2, and LR 96-3

- 1 mylar copy Migration normal and reverse polarity**
- 2 blackline copies Migration normal and reverse polarity**
- digital shot point survey data**
- 1 paper copy of the SP map**



Introduction

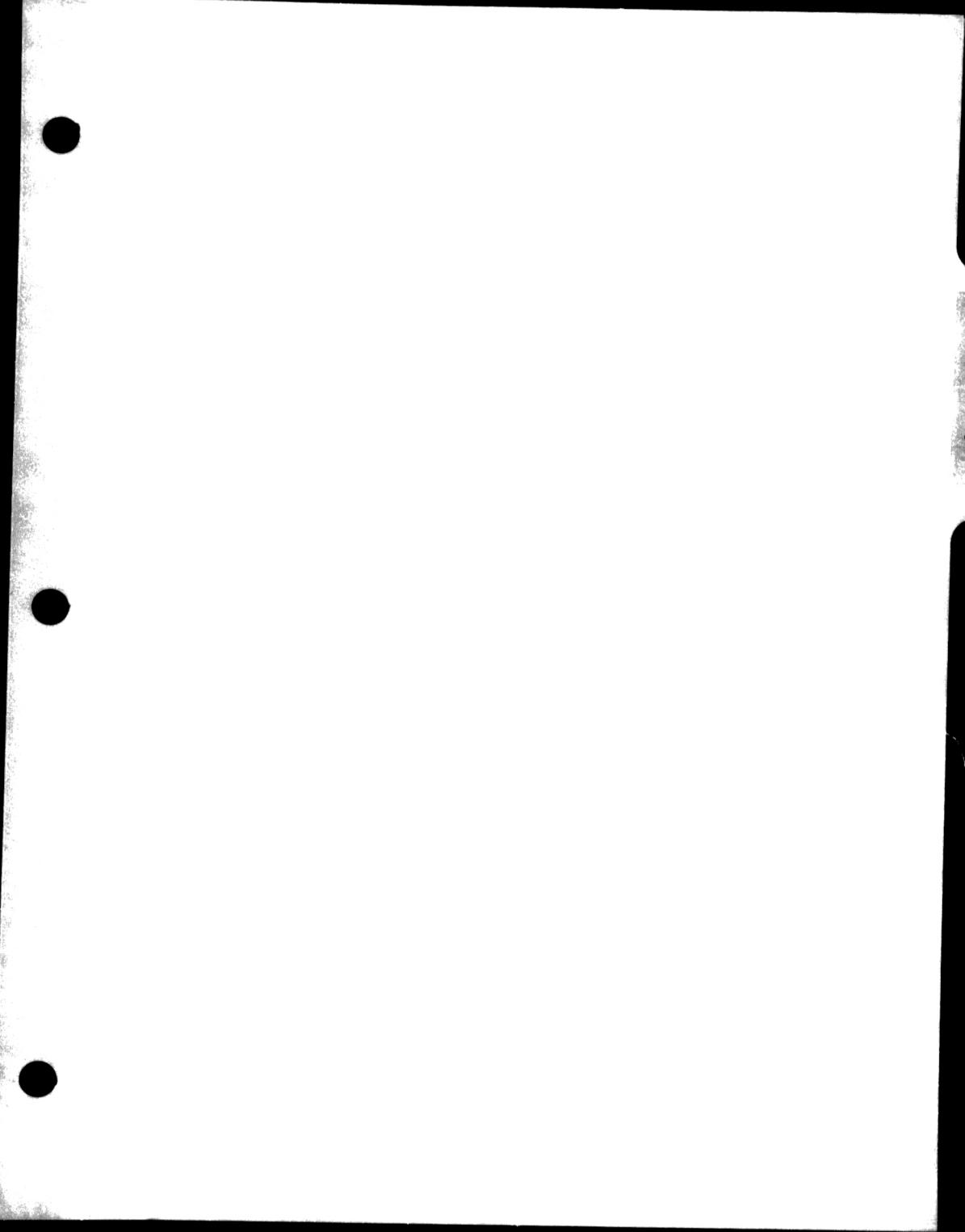
A 62 km vibroseis program was shot in the winter of 1996 to evaluate exploration leads derived from older trade data. Excellent data was obtained despite difficult terrain involving ice bridges across the Liard River. The interpretation of all data on EL 365 shows three possible prospects, of which the northern one looks most attractive. A further detailing seismic program in the winter of 1997 will be required to determine whether this prospect is drillable.



Total km within 3 km of EL 365: 57.4 km

Scale 1:150000

EL 365	LR98-1	LR98-2	E-64	H-16	80 40 0	80 30 0	123 30 0
LR98-1	LR98-2	E-64	H-16	LR98-1	LR98-2	E-64	H-16



Geco-Prakla
A Division of Schlumberger Canada Limited

FINAL REPORT

for

BFR GEOPHYSICAL CONSULTANTS

2D VIBRATOR SEISMIC SURVEY

N.W.T. 1996

January - March, 1996

2D VIBRATOR SEISMIC SURVEY

N.W.T. 1996

for

BFR Geophysical
c/o Geco-Prakla Exploration Services
2500, 801-6th Avenue S.W.
Calgary, Alberta

Land Use Permit #N94B340

BY

Geco-Prakla
2435 - 22nd Street N.E.
Calgary, Alberta

Party 1264

Supervisor: Kevin Plintz
Party Manager: Doug MacDonald

January - March, 1996

FINAL REPORT

for

BFR GEOPHYSICAL

N.W.T. 1996

SEISMIC PROGRAM

Winter 1996

Program

Conduct a 2D Vibroseis data aquisition program in the Fort Liard area of the Northwest Territories.

Location

North and east of Fort Liard at approx. km 81 along the McKenzie Highway. The program crosses the Liard River.

Type

2D Survey consisting of approximately 63 kms.

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INTRODUCTION

A 2D seismic reflection survey was conducted for BFR Geophysical Consultants in the Fort Liard area of the Northwest Territories. The Advance work for the Survey began in December and recording ended in mid March of 1996. The survey was conducted by Geco-Prakla, Party 1267.

The program consisted of 3 lines totalling approximately 63 kilometers.

The topography was at the base of the eastern slopes of the Liard range, mostly muskeg and some heavy underbrush.

The main staging area for the program was at km 91 on the McQuesten Highway north of Fort Liard.

Food, fuel and supplies came generally from Fort Liard and Fort McQuesten and were transported to the camp location by truck.

STATISTICAL DATA

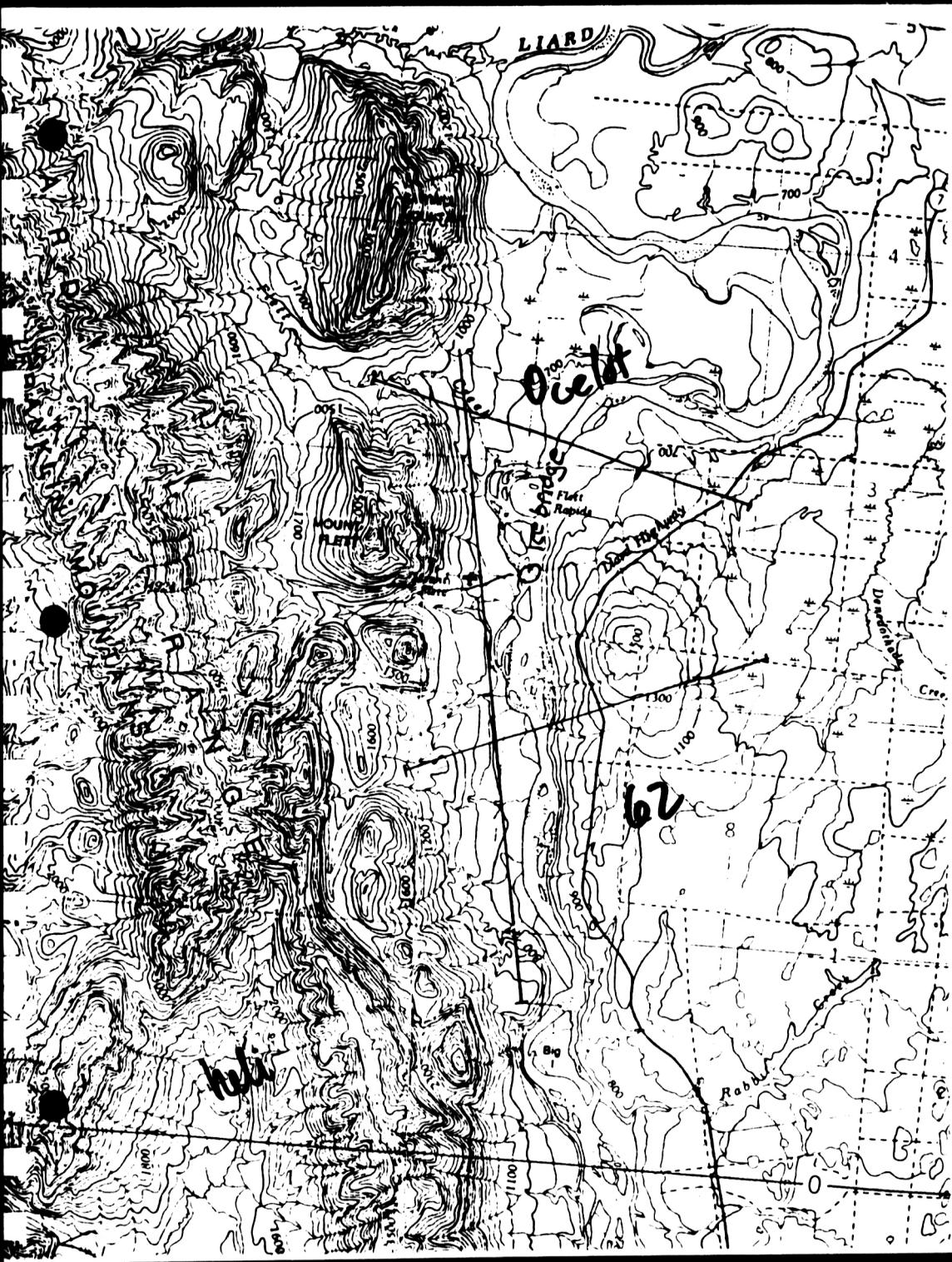
A. Job History

January - March, 1996

December 30	Party Manager travels by truck from Calgary to Fort St. John.
December 31	PM arrives in Fort Liard.
January 9	Plowed snow on ice. Flooded ice for entire shift.
January 10	Flooded ice in morning. Started snowing midday. Catpush Jerry Martin mob from Calgary.
January 11	Catpush Jerry Martin arrived in Ft. Liard. D-6 cat plowed campsite at km 91. No work on ice bridge, waiting for last flood to freeze.
January 12	D-6 continued to clean campsite. Trucked 3 trailers and fuel sloop. Flooded ice up to rough spot. Catpush scouted program on ground, unable to get sunshot due to overcast weather.
January 13	All camp trailers on site. D-6 and D-8 continue to clean campsite. Flooded ice in afternoon. Catpush plotted Ocelot program on topo and setup line LR 96-1.
January 14	Clean main campsite. Test ice bridge (no results yet). Flooded ice in afternoon. Catpush setup line LR 95-2. Will start cutting tomorrow on line LR 95-1.
January 15	Cleanup on main camp continued. (D-8 and D-6) D-6 walked to line LR 95-1. Catpush set off line LR 95-1. Slashers cut doglegs.
January 16	Walked D-8 and D-6 from camp to line LR 95-2. D-6 continued cutting on line LR 95-1.
January 17	Cut line on LR 95-1 and LR 95-2. Flooded ice bridge.
January 18	Moved cats off line. Slashed all line that has been cut.
January 19	Moved cats off line. Advance clerk arrives in camp.
January 20	Moved cats back on line.
January 21	Handcut 50 meters to river.
January 22	Handcut 300 meters to river.
January 23	Only one cat working today doing cleanup.
January 24	Pressure ridge found on ice bridge, will check out tomorrow to see how serious it is. One chaining crew arrives in Ft. Liard.
January 25	Unable to check pressure ridge due to time constraints. One survey crew arrives in Ft. Liard.
January 26	Checked out ice bridge, tested ice is good for D6 cat to cross. Flooding ice now to make it 5 ft. thick all the way across.
January 27	Walking cats to river crossing (1 day). Will probably need alternative slashing arrangements for Ocelot (Nahanni not working out).
January 28	Surveyors will chain tomorrow as right behind chainers. Chainers will work $\frac{1}{2}$ day and then pick-up truck in Ft. Nelson. Built approach to ice bridge, will start logging tomorrow.
January 29	D8 worked on ice bridge access, no cutting today.
January 30	D8 worked on ice bridge access, no cutting today. Logging operations commenced
January 31	Plan to cross D6 cats tomorrow on ice bridge.
February 1	Need to check ice bridge with lowboy before cats can cross.
February 2	Could not test ice as testers broke their augers. Auger to come in morning then cats will cross.
February 3	Trucked cats across icebridge with lowboy, walked on across with ropes.
February 4	Lots of detours around creeks.
February 5	Lots of detours, will require towcat on line 3. (steep hill)

February 6	Estimate 60 hours more for D6 cat time.
February 7	Nightshift cleared 5 km of existing in addition to the 4 km of newcut today. Nahanni will start tomorrow.
February 8	Entire operation shutdown for about 4 hours due to medivac until medic was available again. Both crews chained today.
February 9	Cutting will be complete in 3 or 4 days.
February 11	Chaining crew demobed, will finish the rest of job with one survey crew.
February 12	Completed cutting today, cats to walk out tomorrow.
February 13	Beaver walked out cats, left some cleanup at south end of Line 96-3 as it is currently too soft, they will walk a cat in when it tightens up some at their own expense to finish the work.
February 14	Nahanni complete slashing on line 96-1, they are now finished with their half of the program.
February 15	
February 16	Survey complete on Saturday and complete notes on Sunday.
February 17	Due to heavy snowfall all day (accumulated 10 to 12 inches on line) surveyors did notes, will finish survey on Sunday.
February 18	Survey now completed, survey crew to demob Monday and Tuesday. GPS crew (Solonenko, Moore) working on Ocelot.
February 22	GPS crew on standby Feb 21. A total of 2 days so far. Will need to replow on all lines on program.
February 23	GPS Doug Solonenko processed data and survey data. Bob Moore back pushing cats and slashers.
February 24	GPS processed data and survey data. Snowplow line 96-01 and 96-02.
February 25	Snowplow 2 km of access. Snowplow line 96-01 and 96-02 = 18 km
February 26	D3 plowed ice bridge for 2 hrs.
February 27	GPS tied into control.
March 1	Two D6 cats snowplowing, one D6 with drag, most of Ocelot now plowed out. 3 slashers doing cleanup.
March 2	Slashers 4.2 km on line 96-3.
March 5	Recording crew start laying out on program.
March 6	Steep hill, cats have to make detour before line crew can move in a.m. Vibes detouring around river.
March 7	Cats stuck at bottom of steep hill station 740. Vibes unable to get past till 12 p.m. Vibes having to get winched by towcat.
March 8	One hill required towcat for vibes. A lot of winching for line trucks, long drive. A lot spread to pick up.
March 9	Recorder roll over at 11:00 a.m. Stopped production until tomorrow a.m. Snow storm in p.m. Fresh snow overnight. Steep hills on prospect. Winching and towcats.
March 11	Excellent day for crew.
March 12	Recording on another program.
March 13	Recording on another program.
March 14	Will complete shooting line 1 tomorrow.
March 14	Complete shooting on Ocelot.

VIBRATOR MONTHLY STATISTICAL REPORT
GECO-PRAKLA



B. Production Statistics

Profiles Shot	1569
Days Worked	11
Kms Recorded	62.60 km
Weather Days	0
Total Days	11
Total Hours	128
Total No. Shifts	11
Total Shifts Lost (weather)	0

CAMP

Beaver Enterprises

One (1) 24 man camp with 3 sleepers and a kitchen. The camp was located at km 91 staging along the McKenzie Highway. Cutting crews and survey crews stayed here throughout the program. The recording crew stayed in the town of Fort Liard.

A support vehicle for camp was used for transportation and water hauling.

LINE CLEARANCE

The Line Clearance was done by Nahanni Slashing and Beaver Enterprises Ltd.

Beaver Enterprises

Walter Bertrand
Gordon Kotchea
Henry Bertrand
Norman Sassie
Billy Loe
Herbert Berreault
Clarence Berreault
Freddie Mouye
Fred Bertrand
Raymond Kotchea
Darcy Cooper
Victor Bertrand
Carey Hrycak
Ron Russell
Don Lindsay
Harold Isaiah
Mickael Sassie
Dale Timbre
Archie Bertrand
Gordon Isaiah
Don Bertrand
Patrick Berreault

Nahanni Slashing

Tom Betsaka
Peter Marcellais

Both companies were used for handcutting and cats.

The cutting crews had a total of 10 shifts with no shifts lost due to weather.

SURVEY

Survey was done by Geomat-X Surveys.

Geomat-X Surveys

Hugh Gibbons

Dan Sassie

Chris Hamson

J. Surette

The survey was done using conventional methods, using theodolites and EDM. Trucks and quads were used as support vehicles.

The survey and chaining crew a total of 23 shifts with two shifts lost due to weather.

RECORDING

Geco-Prakla

Supervisor	Kevin Plintz
Party Manager	Bob Dreaver/Doug MacDonald
Field Administrator	Nictima Huet
Instrument Technician	Jim Brack
Observers	Tim O'Connell
Vib Tech	Gord Henniger
Cable Repair	Andre Simoneau
Supplyman	Blair Coull

Recording System

Input/Output System Two™

The I/O SYSTEM TWO™ is an advanced delta sigma technology telemetry data acquisition system offering numerous advanced recording and signal processing features determined to be found on *no other recording system*. Amongst those features are the following:

- Full 24-bit analog to digital recording
- Spectral Shaping Filter (SSF)
- Enhanced Hi-Line Pickup Eliminator (HPE) - step resolution of 0.01 Hz over frequency band of DC to 420 Hz
- Total Self Calibration/Testing
- Increased Spatial Sampling

The I/O SYSTEM TWO™ offers maximum flexibility during field deployment, thereby resulting in increased production. The benefits of digital transmission and the systems inherent protection against Hi-line induced interference make it an ideal choice for this environment.

- Reduced field battery power requirements (45% of System One) solar batteries
- Automatic detection of pilot overscaling for vibroseis
- Low cut filter of 32 frequencies of 3 - 90 Hz @ 12 dB/octave slope
- Alias filters of 100 Hz @ 4ms, 200 Hz @ 2ms, 400 Hz @ 1ms, 750 Hz @ 0.5ms

SSF for 3 start and 3 end frequencies for each of 3 gains, which may allow instrument suppression of the noise trains.

The crew is configured for 2D operations. Sufficient quantities of line equipment (cables, geophones) will be supplied to maintain roll-along.

INPUT/OUTPUT SYSTEM TWO™

I INPUT/OUTPUT SYSTEM TWO digital telemetry system, comprising:

- 135 MRX's with solar batteries
- 133 Spare battery modules
- 2 Battery Charging Systems
- 14 ALX's (Advance Line Taps)
- 1 LIM's (Line Input Module)
- 1 SCM (System Control Module)
- 1 CSM (Correlator/Stacker Module)
- 1 SIM (System Interface Module)

2 SCSI (3480 Cartridge Drives)
1 OCM (Operator Control Module)
2 HHT's (Hand Held Terminal)
1 Printer

1 TOR GEoscience SRM-48P Digital Field Monitor w/VibraSig monitoring
800 Strings of 10 Hz geophones (9 phones/string)
133 Tescorp RSC interconnect cables (6 takeouts @ 42m or 84m)
1 Pelton Advance II ESG

Vehicles - Recording Crew

1 Air conditioned Recording Cabin mounted on a F700 4x4. Separate diesel driven 17 kVA generator supplying power for air conditioning and instrumentation.

1 Party Manager Unit - F250 4x4

3 Line Units - F350 4x4

1 Transport Units - F700 4x4 (or equivalent)

1 Support Unit - F250 4x4

1 Mechanic Unit - F250 4x4

1 Personnel Carrier

1 Battery Charging Unit

1 Cable/Geophone Repair Trailer

2 Snowmobiles

1 Vibrator Technician Unit

1 Fuel Unit and Spare Parts Trailer

4 Mertz M18HD Buggy Vibrators

Communication/Office Equipment

16 VHF mobile radio transceivers fitted to vehicles
8 VHF handheld radio transceivers
1 Facsimile machine
1 Photocopier
1 Portable computer
2 IBM Compatible P.C.'s for administration and cost control

Vibrators and Control Electronics (Version 5.1 Hardware)

- 4 Mertz M18HD Vibrators with Advance II Electronics (Version 5E)
- 1 Vibrator Technician's Unit
- 1 Vibrator Fuel/Support Unit

4 Mertz M 18 HD P-Wave Vibrator units mounted on 4x4 buggy each fitted with the following:

- Pelton Advance II Vibrator Control Electronics (Version 5E)
- Geco-Prakla's Zero Leak Fueling System
- Mandatory Escape Hatches and Catwalks for Safety
- Automatic Low Press Hydraulic Shut Down Systems
- Automatic Air-bag Filling System
- 20,000 lb Hydraulic Winch
- Air Conditioning
- VHF Mobile Radios
- HD modifications increasing peak force to > 50,000 lbs.

Advance II Control Electronics - Features (version 5.1)

- Pelton Version 5E Firmware
- Automatic Performance Reporting - Continuous Checksum and Error Reports
- Vibra*Sig QC Monitoring
- Geco-Prakla VEiW-QC Statistical Analysis Program
- Mandatory Similarity Quality Control Monitoring Daily
- Mandatory Force Meter Analyzing Every Contract
- VEiW-QC Data and Time Motion Summaries Daily
- Enhanced Ground Force Control and Phase Locking

On site computers for tailored sweep design dB/oct, dB/Hz and segmented non-linear sweeps.

Four high output vibrators are to be provided. The units proposed are Mertz M-18HD vibrators mounted on 612 buggies. These units have a peak force in excess of 50,000 lbs over a frequency range of 5-250 Hz.

The vibrators are equipped with Pelton Advance II control electronics which feature enhanced ground force control and phase locking, non-linear sweep (dB/oct and segmented dB/Hz) capability and vibrator QC options.

Pelton DR Servo Valve Enhancement equipped on all Geco-Prakla M-18 Vibrators.

RECORDING PARAMETERS

Line 1, 2, 3 - Ocelot NWT 1996

Program Size	62.6 km
No. of Traces	300
Shot Point Interval	40 m
C.D.P. Size	10 m
Group Interval	20 m
Geophones/Group	
Groups in Gap	2
Geophone Spacing	9 over 20 m
Start Frequency	10
End Frequency	80
Taper	½ sec - ½ sec
Non Linear/Linear	Linear
Sweep Length	12 sec
No. of Sweeps/V.P.	4
No. of Vibs/V.P.	4
Drag	30 m over 20 m
Filters High Cut	Anti Alias, 180 Hz
Record Length	5 sec

SAFETY PROGRAM

For the advance crew safety meetings were held at least once per week. Start up safety meetings and orientations were held with the arrival of the Cutting and Slashing crews, the Survey crew and any visitors to the program. Audits were done on cuts and slashers on January 14 before start up and an evacuation plan was made for the camp.

Safety Advisor Walt Davis arrived in camp on January 22 and held a first aid course on January 23. Walt also did an audit on camp.

The main safety concerns were the cold weather causing several frost bit concerns. There were problems with the ambulance heater causing the medic to be unable to complete radio checks.

Safety briefings included were held regularly with the slashers about not working alone, heating up in trucks and to monitor temperatures.

One incident on February 8, 1996 with a slasher when a tree snapped off and a branch fell and struck the slasher in the head and shoulder. Luckily the slasher was wearing his hard hat which absorbed much of the impact, however the hard hat cracked and face shield and ear protectors broke. A safety meeting was held the following morning with all people working on the program.

The arrival of the Recording Crew brought another start up safety meeting and program orientation on March 5, 1996. The main HSE concerns on the recording crew was with regards to vehicle travel. Weather conditions were warming up causing bad road conditions, poor visibility and a lot of winching of trucks.

One incident on the recording crew was a vehicle rollover on March 9, 1996. The truck was climbing a steep hill with tire chains on and was only able to get within 3 meters of the top. No luck was had with winching. When the driver tried to back down the hill he lost traction with the front wheels and started to slide sideways causing the truck to roll onto its side. Luckily the driver was wearing his seatbelt and was not injured. A general safety meeting was held the following morning with all workers on program to discuss driving and road conditions.

NORTHERN MANPOWER REPORT

The following is a list of northern residents employed by Beaver Enterprises for the Ranger Oil Prospect.

Beaver Enterprises

	<u>Hours</u>
Walter Bertrand	90
Gordon Kotchea	90
Henry Bertrand	90
Norman Sassie	90
Billy Loe	90
Herbert Berreault	90
Clarence Berreault	90
Freddie Mouye	90
Fred Bertrand	90
Raymond Kotchea	90
Darcy Cooper	90
Victor Bertrand	27
Carey Hrycak	90
Ron Russell	90
Don Lindsay	90
Harold Isaiah	38
Mickael Sassie	90
Dale Timbre	90
Archie Bertrand	29
Gordon Isaiah	90
Don Bertrand	90
Patrick Berreault	90

Cooper Barging

Harold Burrill	44
Ronald Russell	44
Leonard Hope	44

Nahanni Butte

Tom Betsaka	150
Peter Marcellais	150

Geco-Prakla

William Bertrand	211.5
Julien Sassie	211.5

In addition to these field positions, E&D Catering employed 1 local for their operation.

Karen Kotchea	264
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Approximately 30 locals were employed for 4 to 6 weeks.

NORTHERN EXPENDITURES REPORT

Geco-Prakla

Northern Business	Nature of Business	Amount
Beaver Enterprises	Line Clearance	309,541.94
Nahanni Slashing	Line Clearance	9,580.00
Beaver Enterprises	Camp	25,350.00
E&D Catering	Catering	28,776.50
William Bertrand	Labor	2,675.40
Julien Sassie	Labor	2,675.40
Great White North	Courier	823.26
Beaver Enterprises	Camp, Catering	5,580.00
Liard Valley General Store	Hotel, Hotshot	3,687.32
Liard Fuel Center	Fuel, Oil	9,279.25
Total Northern Expenditures		397,927.07

CONCLUSION

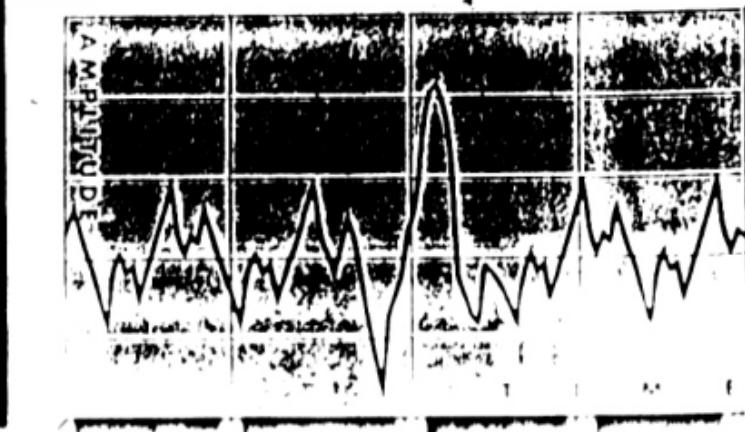
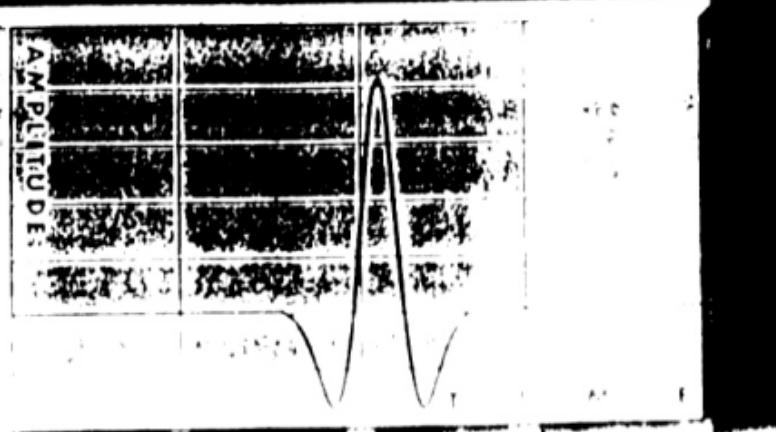
Generally the project went well. Due to large amounts of snowfall after the lines were cut, they had to be replowed before recording crew could start. Creek crossings were pulled upon completion of the job. Land use has cleared all the lines.

Data quality was good throughout the program and completion was on target with respect to BFR's time requirements for processing and interpretation.

IFP Digitization

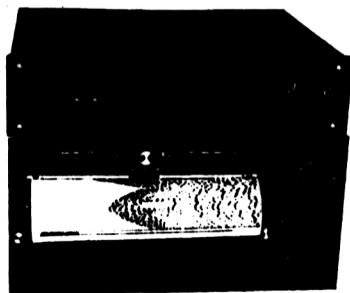


Digital Model of
IFP Recording System

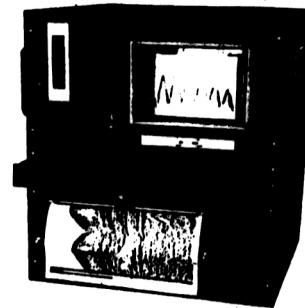


MULTICHANNEL DIGITAL SEISMIC CAMERAS

SRM - 48 SERIES



SRM - 48P



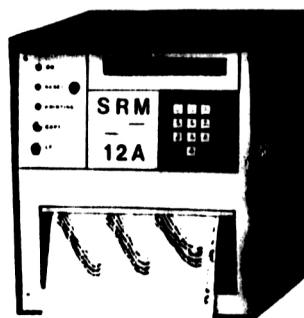
SRM - 48

Thermal paper camera at economical cost.
Prints any number of channels.
Fast with high resolution (203 dots/inch).

SRM - 48 SERIES FEATURES:

- Full 486 PC/AT computer
- High resolution special display for every record
- Choice of thermal plotter or laser printer
- Clean, crisp plots for good quality control
- Raster and/or rainbow screen presentation
- Dual program capacity for vibroseis quality control with the camera working in the background
- Easy paper loading from front panel
- Wiggle and variable area plots
- Modular for convenient installation
- Digital interface to seismic systems
- Maintenance free
- Easily upgradable
- Colour screen

DIGITAL SEISMIC CAMERA SRM - 12A



Thermal paper camera at economical cost.
Prints up to 240 channels.
Fast with high resolution (203 dots/inch).

SRM - 12A FEATURES:

Special purpose computer in conjunction with Gulton
printer/plotter
Digital interface to 60/96/120/240 channel seismic systems
Alphanumeric keypad for editing of header
Maintenance free

For further details contact:

TOR GEOSCIENCE CORP.



#4A, 3704 - 6th Street N.E.
Calgary, Alberta, Canada T2E 7Z9
Tel: (403)230-1300
Fax: (403)241-1291

SRM-48 CAMERA SPECIFICATIONS

Operational:

Maximum Input Channels:	9999
Maximum Plot Channels Time Seq:	550
Maximum Plot Channels Channel Seq:	9999
Maximum Aux channels of Plot channels:	255
Maximum Plot Length:	32 Sec
Interpolation (samples:plot lines):	4:1,2:1,1:1,1:2,1:4,1:8,1:16
Spacing:	1 to 50 Channels / inch
Overlap setting:	16
Plot Display Format:	Time or Channel sequential
Display Mode:	Wiggle or Variable
Spacing Select	Auto or programmed

Standard system configuration:

Motherboard:	PENTIUM-66Mhz
Memory:	16Mb (minimum)
Hard drive:	210Mb (recommended)
Operating System:	MS-DOS 6.22
Monitor	SVGA Color CRT (recommended)

Gulton Geo-Logger Printer:

Print media:	Direct thermal printhead
Media Width:	12"
Resolution:	200DPI
Power	120/240VAC 50/60HZ
Vibration	5 to 55Hz; shock 30G
Temperature	0 to +50C

Physical:

	SRM-48	SRM-48P
Dimensions:	19 1/4" W 21 1/2" H 16 1/4" D	17 3/4" W 13" H 18" D
Weight:	110lb	70lb

PERFORMANCE (PENTIUM-66Mhz system):

Time Sequential 5"/sec, Wiggle, Mod

120CH	240CH	480CH
2 2"/s	2 2"/s	1.7"/s

Trace Sequential Plotting at 20 traces/inch

Wiggle Mode	Variable mode
2.2"/s	1.9"/s

Specifications are subject to change without notice

SRM-48 Camera General Description

SRM-48 consists of a custom PC-AT compatible card and Software written in assembly language utilizing 386 instruction set. It is designed to provide greatest speed with large number of channels. SRM-48 card facilitates interface to I/O system and to Gulton Geologger thermal printer. There are 2 seismic data formats currently accepted: I/O SYSTEM 2, 1 byte SEG-D and SN-388, 8 bit data format. SRM-48 Camera can be configured in a number of various ways.:

- Input can be either from SRM-48 Card or Hard Drive.
- Output in 1 byte SEG-D or SN388 8 bit format to hard drive.
- Output in Raster form to Gulton Thermal printer, Laser Printer or display.
- Output in Rainbow form onto display.
- SRM-48 can work with or without SRM-48 Card.
- Computer platform can be a 386 or better (preferable), active or passive backplane.

SRM-48 captures the seismic data rasterizes and outputs to Gulton or laser printer.

Seismic data can be:

- Captured using SRM-48 card
- Saved to file
- Loaded from file
- Rasterized to form Raster object
- Rainbow displayed

Raster can be:

- Plotted on Gulton
- Plotted on Laser printer
- Saved on Disk

10 various Configurations can be:

- Edited
- Saved and loaded from disk
- Used to override any plot formatting information provided by seismic system.
- Auto sequenced to produce successive plots with different parameters.

Auto sequence is a feature which allows the operator to program the sequence in which all available functions are executed. There can be a one time run or repeated sequence.

Dual programing, Terminate Stay Resident (TSR) feature allows camera processing to done in the back ground. Using TSR software the same computer may be utilized for other functions such as Vibroseis QC while outputting seismic data on camera.

New functions and configuration parameters can be added.

CS-30 CT

THE SUPERLATIVE GROOVEPHONE

A new standard of excellence

DO YOU DESIRE

GS-30CT

CLOSE TOLERANCE GEOPHONE

The latest 24-bit Data Acquisition Systems claim the capability for recording the full dynamic range of geophones without the distortion caused by floating point amplifiers. This challenge to the historic efficacy and superior performance of geophones gave reason for OYO Geospace to develop geophone performance to an even higher level... a level which maintains the geophone as the strongest link in the data acquisition technology chain.

For years OYO Geospace has dedicated R & D efforts to exploring new ways for sensing and measuring motion, and investigating new materials responsive to inertial generation of electrical signals. Investigations of alternate and newly developing technologies have invariably led us to return to the tried-and-true principle of suspending a coil of wire in a permanent magnetic field as the best means of transforming seismic energy into electrical signals.

As a result our efforts have been directed once again to seeking the highest possible performance of the moving coil geophone. The GS-30CT represents the ultimate refinement in geophone design to date. Here is what this new geophone offers:

- Heretofore unattainable geophone-to-geophone uniformity
- Distortion reduced by a factor of 2.5: **New standard < 0.08%**
- Tighter tolerance on geophone parameters: **New standard $\pm 2\%$**

Channel-to-channel uniformity and elimination of self-generated noise and distortion is the essence of seismic data. Towards this end, the performance of the GS-30CT is clearly unsurpassed. Better geophones may be developed in years to come, but today the GS-30CT represents the ultimate refinement in geophone design. It is more than a match for the increased capabilities of the most advanced Data Acquisition Systems.

WATERPROOF LAND AND MARSH CASES

The cases for the GS-30CT are waterproof without the use of internal potting compound. They are made from thermoplastic resins that maintain structural integrity under extreme environmental conditions.

The cases have molded silicone rubber seals that prevent water from reaching the basic unit and protect the cable against flex stress as it enters the case. The patented PCB Anchor/Takeout anchors the cable and

electrically interconnects the geophones on a string. This eliminates the weakness associated with having to bend, twist or knot the cable inside the case.

These low profile cases have metal inserts with female threads molded into the case bottoms for use with male spikes. The strength of this female thread insert/male spike combination is comparable to that of the case material. Field servicing is simple.

* Patent No. 4594698

PC-801-LZ Land Case



PC-801-EP Land Case



PC-901 Marsh Case



PC-801-LPC Land Case

The Low Profile Comical PC-801-LPC Land Case improves ground coupling and minimizes wind noise. The tapered base facilitates easy field layout and helps assure correct orientation.

PC-801-LP Land Case

The PC-801-EP Land Case has a removable metal base cup with traditional male stud for use with female spikes and tripod or comical base. When used with the T-5 arctic base,

the PC-801-EP does not require the metal base cup.

PC-901 Marsh Case

The PC-901-LP improves the threaded assembly of traditional marsh cases. The case top and bottom are pushed together in a tub and slot configuration and locked with a spring tempered stainless steel retainer ring. Two O-rings and a special silicone rubber seal makes the case waterproof. The drop cable is soldered to the PCB. Anchor Takeout for optimal strength and load distribution is optional.

GS-30CT CLOSE TOLERANCE GEOPHONE

SPECIFICATIONS

Specifications calculated at 20°C

Operational Range for all Parameters

Vertical to 20 degrees

Frequency

Natural Frequency (Fn):

10 Hz \pm 2%

Typical Spurious Frequency:

> 160 Hz

395 ohms \pm 2%

Distortion

Harmonic Distortion measured at 12 Hz

with driving velocity of 0.7 in/sec

(1.8 cm/sec) P-P:

< 0.08%

Damping

Open Circuit Damping (B₀)

for 395 ohm coil:

30.6%

Shunt Resistance for

100% Damping (R_{sh})

1000 ohms for 30% damping

$\pm 2\%$

Damping Tolerance with shunt:

Sensitivity

Intrinsic Voltage Sensitivity (G):

700 V/in/sec (276 V/cm/sec)

Sensitivity at 70% Damping:

500 V/in/sec (197 V/cm/sec) $\pm 2\%$

Damping Constant (B_cR_f):

549.4

Normalized Transduction Constant:

.035 $\sqrt{R_c}$ V/in/sec (.0138 $\sqrt{R_c}$ V/cm/sec)

Physical Specifications

Moving Mass (M):

388 oz (11 g) $\pm 2\%$

Case to Coil Motion P-P:

>.060 in (> 152 cm)

Operating and Storage Temperature:

-45 to +100°C

Dimensions (less terminals*)

Height

1.30 in (3.30 cm)

Diameter

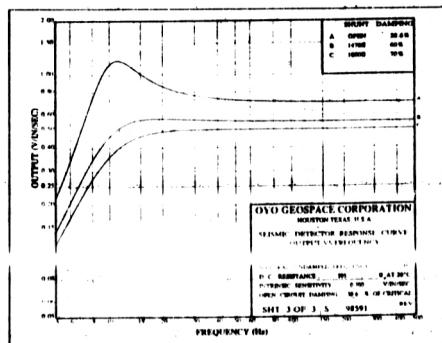
1.00 in (2.54 cm)

Weight

3.1 oz (88 g)

*Terminal height is .16 in (4.1 cm)

Specifications are subject to change without notice



• OYO GEOSPACE

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I/O SYSTEM TWO

Recording Capacity	Sample Interval			
	4 ms	2 ms	1 ms	0.5 ms
Total Channels	8064	4032	2016	1008
Single Line Channels	2016	1008	504	252
Line Capacity	1 - 512 Active Lines			
Roll Capacity	Equal to Channel Capacity			
Telemetry				
Cable Construction	Twisted-pair Wire Conductors			
Fault Tolerance	Automatic Telemetry Rerouting			
Maximum Station Interval	360 feet (110 meters) without repeaters			
Maximum Distance Between Lines	2200 feet (671 meters) without repeaters			
Auxiliary Channels	12 Total, Including 4 Filtered			
	Full Performance Aux Channel Test Oscillator			
	Automatic Pilot Quality Check			
Look Ahead Test	On-line, Full Specification Performance Test of Entire Channel Capacity			
Calibration	Automatic Gain Calibration			
	Automatic DC Offset Removal			
Test Capability				
	System Dynamic Range			
	Equivalent Input Noise			
	Group Impedance			
	Common Mode Rejection			
	Crossfeed			
	Distortion			
	Attenuator Step Accuracy			
	Pulse Test			
	HPE Performance Test			
	Signal Dependent Noise Evaluation			
	Spread Noise Evaluation			
	Geophone Performance Test			
	Cable Fault Detection			

All tests are remotely selectable and analyzed in the field. Automatic and resident daily, weekly, monthly and Look Ahead Tests may be selected.

Test Oscillator	79 Different Sine Wave Frequencies: 7.8-960 Hz
	Wide Spectrum Summed Sine Wave Pattern
	13 Pulse Patterns of 5 Widths and 2 Types
	173 DC Levels

All oscillator signals may be attenuated by a quaternary 11-step attenuator and can be applied as difference mode or common mode.

Electronic Logs	Observer's Log and Script Import Capability
	Look Ahead Test Results
	Battery Status
	Telemetry Analysis
Remote Status Monitoring	Battery and Power Supply Voltages
	Battery Usage
	MRX Temperature and Humidity
	Preamplifier and ADC Overdrives
	Data and Command Telemetry Errors
Remote Test Station (RTS)	Retrieves MRX Status
	Tests Field Telemetry Cables
	Tests Line Tap Telemetry Transmissions
	Performs following tests on MRX:
	Dynamic Range Determination
	RMS Noise
	Frequency Response
	Common Mode Rejection
	Harmonic Distortion
	HPE Performance
	Crossfeed
	Signal Dependent Noise Evaluation
Correlation and Summing	On-line correlation process verification
	Full precision and real time correlation
	Correlates and stacks
	up to 2016 channels per module
	Correlation before or after stack
	Correlated or uncorrelated stack output
	when in stack before correlation mode
	Simultaneous dual sweep operation
	Multi-sweep capability
	with compatible noise algorithms
	Diversity edit noise algorithm
	Full system channel capability
Seismic Data Display	Selectable Playback Low-Cut Filters and Slopes
	Selectable High-Cut Filters
	Digital AGC or PGC Modes with Selectable:
	Trip Delay
	Trip Sensitivity
	AGC Rate
	Initial Gain
	Final Gain
	Output Attenuation
	Defloat Mode
	Output Attenuation Settings
	Polarity Selection
	Start/Stop Time Selections
	Channel Selections
	Title Block Annotation
	Oscilloscope Line Monitoring

SPECIFICATIONS

MINIATURE REMOTE SIGNAL CONDITIONER (MRX)

Remote Signal Conditioner (MRX)

A/D Converter 24-Bits (23 + Sign)

Data Channels Per MRX 6

Sample Interval 4 ms 2 ms 1 ms 0.5 ms
Channel Capacity 8064 4032 2016 1008

Line Capacity 1 to 512

Preamplifier K-Gain 12, 24, 36 or 48 dB

Dynamic Range

Non-Shorted Input 8.7-135 Hz, 650 Ohm Source, 2ms Sample Interval

Instantaneous DR 120.0 dB @ 12 dB K-Gain

119.3 dB @ 24 dB K-Gain

115.0 dB @ 36 dB K-Gain

104.1 dB @ 48 dB K-Gain

Total Dynamic Range 140.7 dB

Equivalent Input Noise

Non-Shorted Input

8.7-135 Hz, 650 Ohm Source, 2ms Sample Interval

1.408 μ V RMS @ 12 dB K-Gain

0.381 μ V RMS @ 24 dB K-Gain

0.157 μ V RMS @ 36 dB K-Gain

0.137 μ V RMS @ 48 dB K-Gain

Maximum Input Signal

1408 mV RMS @ 12 dB K-Gain

352 mV RMS @ 24 dB K-Gain

88 mV RMS @ 36 dB K-Gain

22 mV RMS @ 48 dB K-Gain

3982 mV P-P @ 12 dB K-Gain

996 mV P-P @ 24 dB K-Gain

249 mV P-P @ 36 dB K-Gain

62 mV P-P @ 48 dB K-Gain

Distortion 0.0005% THD

Channel Gain Matching 0.1%

Common Mode Rejection 100 dB or greater

Crossover Isolation 110 dB or greater

Frequency Response 3-750 Hz

Time Standard 1 ppm

Input Impedance

Differential Mode 20K Ohms in parallel with 0.1 μ F

Common Mode 250K Ohms @ 50-60 Hz

Power Usage (MRX)

Continuous Operation at 25 °C

One Battery (MBP) 36 Hours

Two Batteries (MBP) 72 Hours

Conventional MRX-1

Dimensions 9.6" x 9.6" x 7.9"

(24.4 cm x 24.4 cm x 20.0 cm)

Weight 15 lb (6.8 kg)

Amphibious MRX-2

Dimensions 9.6" x 9.6" x 8.7"

(24.4 cm x 24.4 cm x 22.1 cm)

Weight 16.2 lb (7.3 kg)

MRX Filters

All filters are resident and remotely selectable including:

• Digital Anti-Alias Filters Linear or Minimum Phase Response

540 or 750 Hz @ 1/2 ms

270 or 400 Hz @ 1 ms

135 or 200 Hz @ 2 ms

68 or 100 Hz @ 4 ms

Rejection above Nyquist Frequency -135 dB

Passband Ripple +/-0.1 dB

• Digital Low-Cut Filters (ON or OFF as desired)

32 Frequencies: 3-90 Hz

Slope: 12 dB/octave

• Digital Hi-Line Pickup Eliminator (HPE) (ON or OFF as desired)

(Simultaneous cancellation of 3 selectable frequencies)

Power Line Related

50 or 60 Hz (Harmonics and Sub-harmonics)

Fixed Frequencies

Selectable from 3 to 420 Hz

in 0.01 Hz increments

Rejection

80 dB or greater

• Spectral Shaping Filter (ON or OFF as desired)

(3 Start and 3 End Frequencies for each of 3 End Frequency Boosts)

End Frequency Boost	12dB		16dB		24dB	
	Start	End	Start	End	Start	End
Frequency (Hz)	17.2	60.5	20.1	149.0	20.2	323.3
Frequency (Hz)	28.0	98.3	32.7	242.0	32.9	525.3

MRX Ambient Environmental Specifications

Operating Temperature -50 to +75 °C

Humidity Range 0 to 100%

Operating Altitude To 5500 meters

SPECIFICATIONS

CENTRAL RECORDING ELECTRONICS

System Control Module (SCM)

Dimensions	26.1" x 17.6" x 11.3" (66.3 cm x 44.7 cm x 28.7 cm)
Weight	75 lb (34.1 kg)
Power	75 Watts

Line Interface Module (LIM)

Dimensions	26.1" x 17.6" x 11.3" (66.3 cm x 44.7 cm x 28.7 cm)
Weight	75 lb (34.1 kg)
Power	105 Watts
Channel Capacity	1008 Channels @ 2 ms
Line Capacity	1 to 128 input lines

Operator Console Modules (OCM)

OCM	Standard Console
PC Platform	486/386 IBM compatible PC
OCX	Portable Console
PC Platform	Ruggedized 486 IBM compatible PC
Dimensions	24" x 15" x 8" (60.9 cm x 38.1 cm x 20.3 cm)
Weight	38 lb (17.2 kg)
Power	350 Watts

Correlator Stacker Module (CSM) optional

Dimensions	14" x 17" x 26.5" (35.6 cm x 43.1 cm x 67.3 cm)
Weight	120 lb (54.4 kg)
Power	250 Watts @ 12VDC

Correlation Capacity	Sample Interval/Channel Capacity			
	4 ms	2 ms	1 ms	0.5 ms
One CSM	2016	1008	504	252
Four CSMS	8064	4032	2016	1008

Tape Transport Modules (TTM)

TTM	Standard 9 Track @ 1600/6250 bpi
Dimensions	17" x 20" x 29" (43.2 cm x 50.8 cm x 73.7 cm)
Weight	155 lb (70.3 kg)
Power	290 Watts

TTM Model 10	Portable 9 Track @ 1600/6250 bpi
Dimensions	24" x 20" x 15" (61.0 cm x 50.8 cm x 38.1 cm)
Weight	115 lb (52.3 kg)
Power	250 Watts

TTM Model 42	Standard 18 Track @ 37,871 bpi (IBM 3480 compatible)
Dimensions	22.4" x 11.0" x 14.0" (56.9 cm x 27.9 cm x 37.6 cm)
Weight	52 lb (23.5 kg)
Power	250 Watts

TTM Model 40	Portable 18 Track @ 37,871 bpi (IBM 3480 compatible)
Tape Unit	Controller Unit
Dimensions	32" x 16" x 9.5" (81.3 cm x 40.6 cm x 24.1 cm)
Weight	55 lb (25 kg)
Combined Power	35 lb (15.9 kg)

Data Recording Tape Formats

SEG-D 8058	4-Byte IEEE Demultiplexed*
SEG-D 8048	4-Byte Demultiplexed
SEG-D 8015	2.5-Byte Demultiplexed

*IEEE format is documented in
ANSI/IEEE Std 754-1985

Ambient Environmental Specifications Central Recording Modules

Operating Temperature	0 to +50 °C
Storage Temperature	-40 to +75 °C
Humidity Range	0 to 100% (Non-Condensing)
Operating Altitude	To 5500 Meters

SPECIFICATIONS

SYSTEM EXPANSIONS AND PERIPHERALS

Advanced Line Tap (ALX)

Dimensions 19.4" x 18.9" x 9.5"
(49.3 cm x 48.0 cm x 24.1 cm)
Weight 32 lb (14.5 kg)

MRX Carrier Rack

Capacity 9 MRX units (MRX-1 or MRX-2) and
10 MRX batteries (MBP or SBP)
Dimensions 30.3" x 20.5" x 35.4"
(76.9 cm x 52.1 cm x 89.9 cm)
Weight 91 lb (41.2 kg)

Line Check Module (LCX)

Dimensions 21.0" x 18.0" x 8.0"
(53.3 cm x 45.7 cm x 20.3 cm)
Weight 34.5 lb (15.7 kg)

Battery Packs

MRX-1 Battery Pack (MBP)

Operation 36 Hour operation at 25 °C
Dimensions 8.6" x 8.6" x 5.25"
(21.8 cm x 21.8 cm x 13.3 cm)
Weight 15.2 lb (6.9 kg)

MRX-1 Solar Battery Pack (SBP)

Operation 120% of typical MRX power
Dimensions 8.6" x 8.6" x 5.25"
(21.8 cm x 21.8 cm x 13.3 cm)
Weight 16 lb (7.2 kg)

Battery Charger (MBC)

Capacity 16 batteries (MBP or SBP)
Line Voltage 85 to 265 VAC
Line Frequency 47 to 63 Hz
Input Power 750 VA
Dimensions 5.8" x 27.6" x 15.4"
(14.7 cm x 70.1 cm x 39.1 cm)
Weight 31 lb (14 kg)

Input/Output, Inc. reserves the right to change its product specifications at any time without notice, in order to provide the best possible products and services.



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SECOND GENERATION

I/O SYSTEM TWO

MICROWAVE EXPRESS

M

Microwave Express is the latest performance enhancement for the I/O SYSTEM TWO. The microwave link enables the I/O SYSTEM TWO user to quickly implement a telemetry connection between adjacent MRX or RSX signal conditioners without cables.

The primary function of the link is to facilitate production in areas where normal cable operations are prohibitive and where obstacles may present a safety hazard for the line crew. Rivers, river valleys, lakes, swamps, canyons, gullies, steep embankments, trees, foliage, and

be effectively traversed using Microwave Express.

Operationally, the Microwave Express is easily and quickly deployed. The microwave unit connects to the nearest MRX or RSX on either side of the desired crossing. An audible signal strength indicator on each unit is used by the line crew to optimize the alignment of the antennae, thus maximizing transmission reliability. Working in conjunction with Cable Express, the system automatically routes the telemetry for power, command and data transmissions. The Microwave Express has its own 12 VDC power source which is remotely monitored from the operator console. Remote battery monitoring allows the operator to effectively manage the microwave link from the recording console.

Microsystem Two is an effective solution in difficult or hazardous terrain often encountered in today's high capacity, high production seismic acquisition. This is particularly true for the I/O System Two, which can now offer the operator a cost



effective alternative to the demanding use of a microwave link to maintain high production. The I/O Microwave Express provides the crew with a safe and economical solution to challenging and hazardous topographic situations.

Microwave Express Specifications

Channel Capacity	336 channels at 2ms sampling rate.
Range	2.0 miles (3.2 kilometers) under normal atmospheric conditions. Line of sight is required between Microwave Express Units for transmission.
Compatibility	I/O SYSTEM TWO MRX and RSX I/O SYSTEM ONE RSC also available
Power	12 Volt DC commercial battery, Solar Assist Panel Available Upon Request
Transmission Characteristics	Frequency Range 2.45-2.48 GHz (ISM) Transmit Power 1 watt
Battery Monitoring	OCM Battery Management Menu
Dimensions	14.1 in. x 10.1 in. x 4.8 in. (357mm x 257mm x 122mm)
Weight	15 lb (6.8 kg)
Mounting Hardware	Various mounting hardware available upon request. Telescopic tripods available for extended height requirements.



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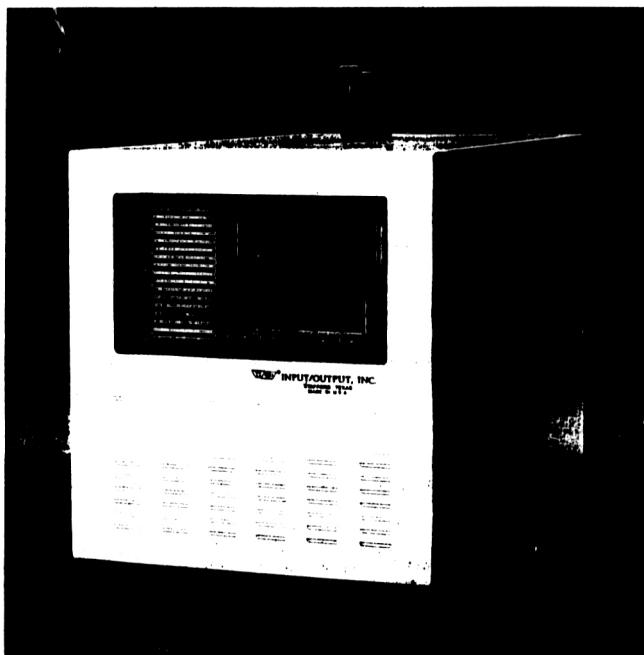
SECOND GENERATION

I/O SYSTEM TWO

MODEL 45 TAPE TRANSPORT MODULE (TTM)

The Model 45 TTM is the latest development in high performance tape recording devices from Input/Output. This new device enhances productivity with efficient high density recording and high speed rewinding capabilities. The modular one piece recording unit and the small cartridge tape media substantially reduce tape handling costs in the field. Features of the Model 45 TTM include:

- Records data onto 18-track, 1/2" cartridge tape (IBM 3480 format). This cartridge tape is easily handled and requires less space for transportation and storage than conventional reel-to-reel tape.
- The compact and lightweight design of the Model 45 TTM makes it easily installable in field recording applications.
- Front dust cover protects sensitive tape mechanisms from harsh and unpredictable field environments.
- Model 45 TTM interface is compatible with I/O SYSTEM ONE or I/O SYSTEM TWO Central Electronics.
- Multiple tape drives may be connected on line for high capacity recording acquisition.
- The I/O SYSTEM Central Electronics continually monitors the Model 45 TTM unit providing the operator with complete status on all taping functions.



Model 45 TTM Specification

Recording Media Type	Single cartridge, 1/2" width (IBM 3480)		
Tape Capacity	200 Mbytes		
Tape Length	540 to 590 feet (165 to 180 meters)		
Cartridge Size	1.0" x 4.3" x 5.0" (2.6cm x 11.0cm x 12.7cm)		
Tape Speed	2.0 meters/sec		
Number Of Recording Tracks	18		
Recording Method	GCR		
Data Recording Density	37,871 bpi		
Unit Dimensions	22.4" x 11.0" x 14.8" (56.9cm x 27.9cm x 37.6cm)		
Unit Weight	15 lbs. (6.8 kg)		
Power	250 Watts		
Voltage	110 V/220V		
Environmental Conditions	<i>Non-</i>		
Temperature	Operating +10 to +40°C	Operating 0 to +50°C	Storage -40 to +60°C
Humidity	20 to 80%	8 to 95%	5 to 95%



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SECOND GENERATION

I/O SYSTEM TWO

POWERING SYSTEMS

P

Power Monitor (PM-1)

The Power Monitor is designed to give the I/O SYSTEM TWO observer needed information concerning the status of the power plant, power supplies and power distribution system associated with the I/O SYSTEM TWO Central Electronics. The PM-1 displays the voltage, current and frequency of the primary AC voltages as well as the voltage and current of all DC voltage supplies.

The PM-1 allows the observer to turn on and off both the AC and DC voltages directed to the I/O SYSTEM TWO or any peripheral equipment.

By using state-of-the-art technology the monitoring system is highly accurate and superior to conventional analog metering systems.



Power Supplies and Power Inverters

Power is supplied to the I/O SYSTEM TWO Central Electronics by a combination of specialized power modules. These power modules are assembled to provide maximum operating efficiency in a wide range of temperature and humidity. The power modules provide all necessary AC and DC voltages for the operation of all recording electronics and peripheral equipment.

Both the Power Supply and Power Inverter are available in portable environmental packages for operation in unsheltered recording instrument environments. These power modules are standard equipment with the I/O SYSTEM TWO Portable Modules.



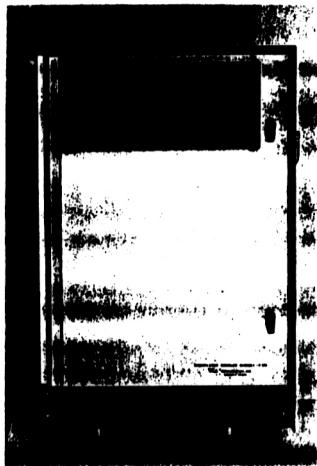
SECOND GENERATION

I/O SYSTEM TWO

CORRELATOR STACKER MODULE (CSM)

The Correlator Stacker Module (CSM) is an advanced technology full precision unit which provides real-time correlation and stacking up to 2016 channels at 4 millisecond sample interval or equivalent channels- sample interval per module.

The operator enters all CSM parameters and commands at the Operator Console Module by keyboard input.



Specifications

Dimensions 14" x 17" x 26.5" (35.6 cm x 43.1 cm x 67.3 cm)

Weight 120 lb (54.4 kg)

Power 250 Watts @ 12VDC

Correlation Capacity

Sample Interval/Channel Capacity

	4 ms	2 ms	1 ms	0.5 ms
One CSM	2016	1008	504	252
Four CSMs	8064	4032	2016	1008

The CSM features:

- On-line correlation process verification
- Full precision real time correlation and stacking
- Correlation and stacking of up to 2016 channels per module
Record lengths up to 64 seconds and listening periods of up to 32 seconds at 2 msec sample interval
- Correlation before or after stack
- Correlated or uncorrelated stack outputs
- Correlated and uncorrelated stack output when in stack before correlate mode
- Simultaneous dual sweep operation
- Multi-sweep capability with compatible noise algorithms
- Burst Edit only noise editing
- Diversity Stack noise editing
- Diversity Stack plus Burst Edit noise editing
- Dual Noise Algorithm (DNA)
- Inverse Power Scaling and Burst Edit

SECOND GENERATION

I/O SYSTEM TWO

CORRELATOR STACKER MODULE (CSM)

CORRELATOR STACKER MODULE NOISE EDITING

The Correlator Stacker Module (CSM) allows the selection of four types of noise editing: BURST, DIVERSITY, BURST + DIVERSITY and DUAL NOISE ALGORITHM (DNA). In addition, the operator may select no editing.

Burst Edit: 3—Each incoming trace is scanned for large short duration amplitude deviations from the norm prior to the stacking operation. When an amplitude "burst" is identified, it is zeroed. Zeroing begins and ends at zero crossings, minimizing discontinuities and phase problems.

Diversity Stacking: The algorithm used divides each trace into time windows (gates) and performs an inverse power scaling on these trace windows prior to the stacking operation. Final stacked data are renormalized to the inverse sum of each trace window value. Window lengths are operator selectable from 64 to 2048 milliseconds and steps by powers of 2.

Dual Noise Algorithm (DNA): DNA is a combination of "burst" editing and an inverse power scaling algorithm. The CSM calculates the average power, not the average amplitude, for each individual channel during each record after "burst" editing. Every trace is weighted by a factor which is inversely proportional to the power in the trace. Data which has been removed as noise is excluded from the averaging process. By maintaining separate scaling factors for each sweep type the DNA allows up to 8 different sweep types to be used.

Signal only	Correlate after stack	Correlate before stack
No noise edit	Yes	Yes
Burst Edit only	Yes	Yes
Diversity Stack	Yes	Yes
Diversity Stack & Burst Editing	Yes	Yes
DNA	No	Yes

The above chart shows the various combinations of noise editing, noise reduction and correlation available for output to tape.

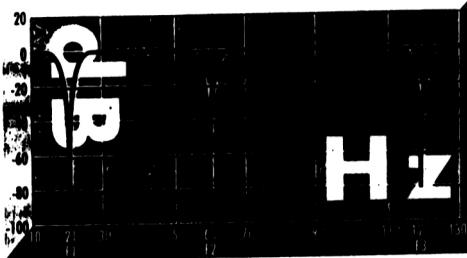
For all Noise Editing modes, the CSM automatically adjusts the edit thresholds to accommodate for varying signal amplitudes due to ground conditions, source offsets, rolling on and rolling off the spread and noisy or inoperative geophone groups.



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SECOND GENERATION ENHANCED HI-LINE PICKUP ELIMINATOR (HPE)



MULTIPLE FREQUENCY REJECTION

Effective data acquisition is often hampered by the presence of interfering multiple coherent noise sources unrelated to the seismic source.

In addition to power line interferences, these noise sources may be the result of exploration or production activities such as pump stations, compressors and drilling activities.

Effective receiver array design becomes a difficult task when these obstacles are encountered. Adequate attenuation of these various noise signals is rarely successful, as low-cut filters and analog notch filters make only coarse attempts at removing the contaminations.

New refinements to the patented Hi-Line Pickup Eliminator (HPE) allow the I/O SYSTEM to simultaneously reject up to three interfering frequencies. Continuous analysis of the phase and amplitude of these contaminating frequencies enables the HPE to converge and effectively eliminate the interference, resulting in enhanced reflection data.

The operator may choose to eliminate frequencies over a range of 31 Hz to 420 Hz. The frequencies are chosen in step increments of 0.01 Hz with a notch width rejection of 3.3 to 33 percent in 0.1 percent increments. The total amplitude rejection at the notch center frequencies is 80 dB or greater. The transfer functions of the filters are exactly known, allowing accurate dephasing to be applied to the data set during processing, if required.

Here are some examples of the Enhanced Hi-Line Pickup Eliminator (HPE) usage:

1. The operator may encounter a survey site with high amplitude noise signals of 15.5 Hz, 17.3 Hz and another harmonically related noise signal of 31 Hz. The operator selects the frequencies and notch widths to cancel all three noise signals. The HPE will reject the selected frequencies with an attenuation of 80 dB or greater.

Another survey location may have high-line related interference of

60 Hz and its harmonic of 120 Hz. A low frequency noise signal of 21 Hz is also observed. The operator selects the frequencies to be cancelled and the width of the notch, again resulting in an 80 dB or greater rejection.

The powerful new technology of Enhanced HPE continuously analyzes the exact phase and amplitude of the contaminating frequencies, thus enabling the I/O SYSTEM TWO to perform more effective cancellation during acquisition than can be obtained in the later stages of data processing.

SECOND GENERATION

I/O SYSTEM TWO

SPECTRAL SHAPING FILTER

Ithe earth's filtering effect on reflected seismic data many times yields recorded seismic events with poor Spectral Dynamic Range. The objective of most data processors is to remove the effect of the earth's filtering and present a broad spectrum data set for analysis and interpretation.

Attempting to spectrally broaden data after the input stage or digitization may yield a processed data set void of low amplitude, high frequency reflection data due to large amplitude low frequency noise.

The goal of any filtering and signal shaping procedure, whether low frequency attenuation or high frequency amplification, should be to improve the recorded signal-to-noise ratio.

The flexibility of the Spectral Shaping Filter (SSF) high frequency boost provides the ability to configure the I/O SYSTEM TWO to deliver the best signal-to-noise ratio for a wide variety of acquisition objectives.

Two areas of improvement made possible with the Spectral

Shaping Filter and the I/O SYSTEM TWO are:

1. Increased Instantaneous Dynamic Range.
2. Increased seismic Signal-to-Noise Ratio when at less than full K-Gain.

When taken together, these improvements result in increased effectiveness of data processing algorithms.

The Spectral Shaping Filter provides the ability to vary the preamplifier gain as a function of frequency. It is an integral part of the preamplifier of each channel and can be selected to be ON or OFF as desired. When the Spectral Shaping Filter is applied to the incoming signal, the overall preamplifier transfer function becomes as follows:

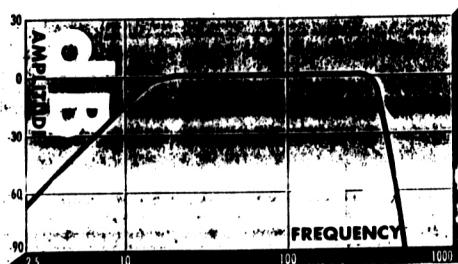
1. Below the start frequency, the preamplifier gain is the preamplifier gain value selected.
2. Between that start frequency and the stop frequency, the preamplifier gain increases at a rate of 6 dB/octave.
3. Above the stop frequency, the preamplifier gain is equal to the sum of the initially selected pre-

amplifier gain value and final boost of the Spectral Shaping Filter.

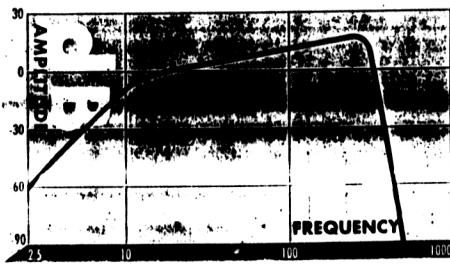
The transfer functions of the filters are known and thus allow for accurate dephasing techniques to be applied to the data set in processing.

For example, assuming a minimum preamplifier gain setting, we select the SSF to have a start frequency of 10 Hz and a final boost of 18 dB. Frequencies 80 Hz and higher will receive an additional gain of 18 dB. This results in an added 18 dB of resolution for all input data from 80 Hz to the anti-alias filter setting.

The characteristics of the seismic signal are the primary reason the SSF is so effective. The high frequency energy from the source is naturally attenuated by the frequency response of the earth. The low frequency source energy is affected much less by the earth's response. This difference in energy allows for an improvement in the recorded bandwidth and the signal-to-noise ratio by using the Spectral Shaping Filter.



Filter Response - No Spectral Shaping

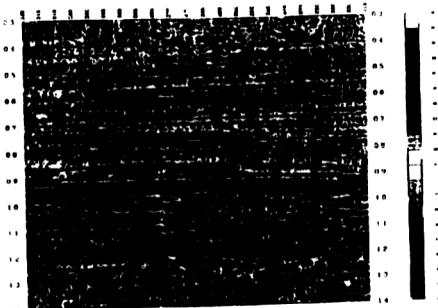


Filter Response - With Spectral Shaping

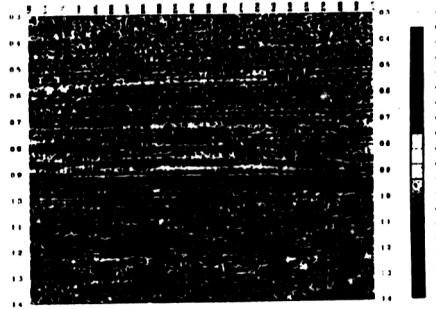
SECOND GENERATION

I/O SYSTEM TWO

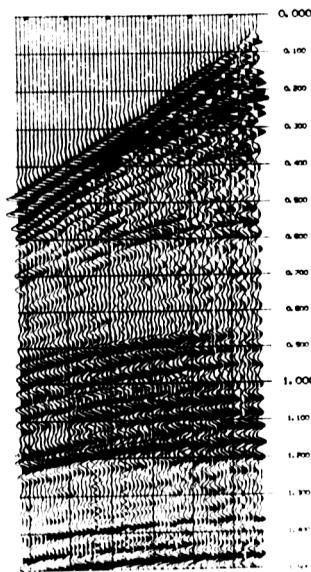
SPECTRAL SHAPING FILTER



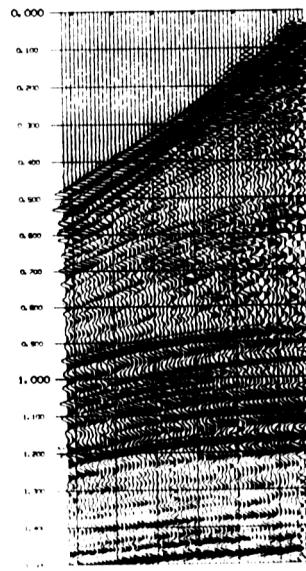
Frequency Attribute—No Spectral Shaping



Frequency Attribute—With Spectral Shaping



No Spectral Shaping



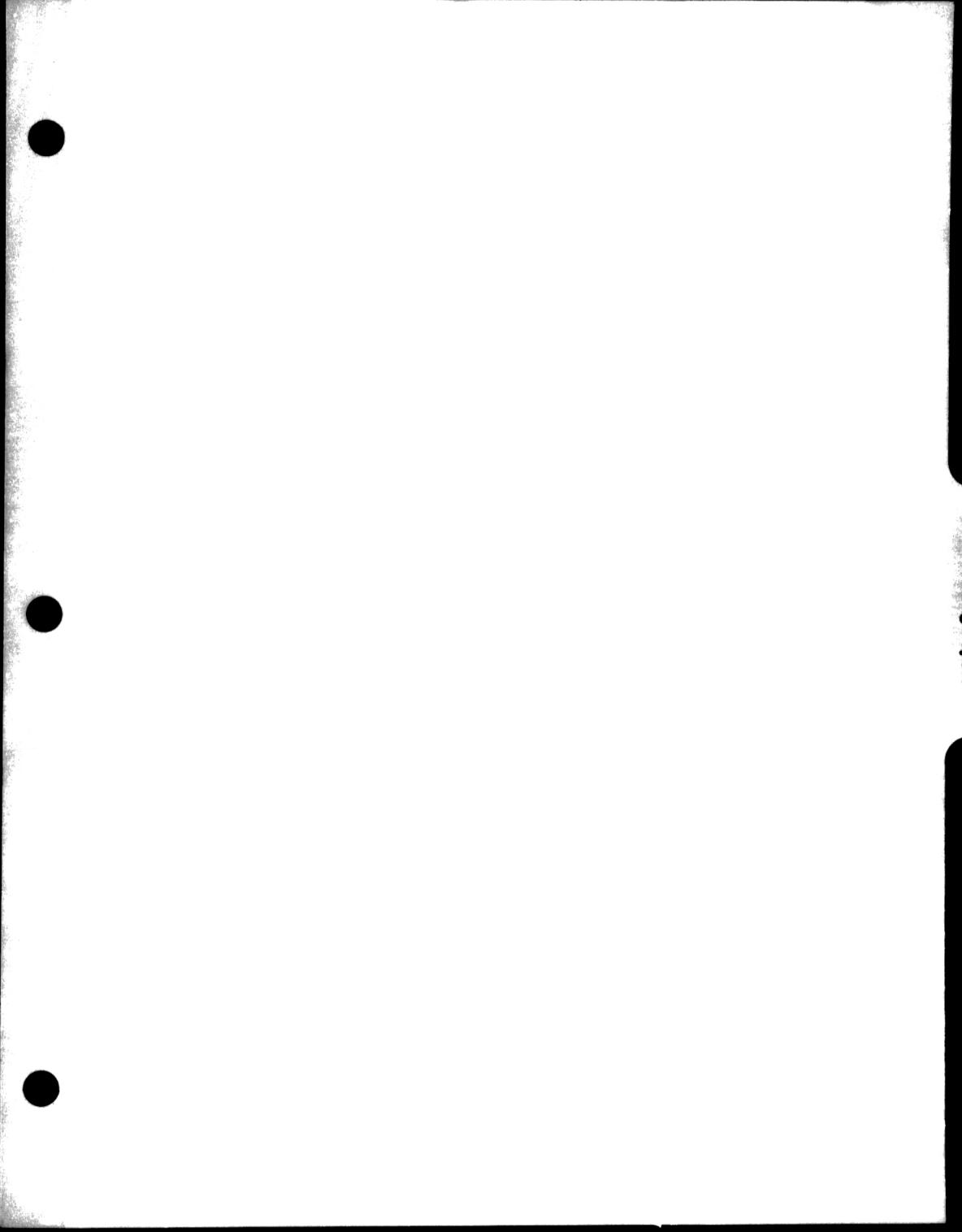
With Spectral Shaping



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Seismic Processing Report

The processing sequence involved standard pre-stack dip move-out (DMO) and a mild FK filter to remove random noise generated in gravel areas near rivers. The processing was done by CGG in Calgary.

Following is a complete list of processing procedures and parameters:

Reformat Segy to CGG format

Recorded 5 S 2.0 MS
Processed 5 S 2.0 MS

Raw Record Display

Spherical Divergence Gain Recovery (A) T ** 1.8

Trace Editing

Predictive Deconvolution

Operator Length: 100 MS LAG 12 MS
Window: 400-4000 MS (Near
Offset)

Prewhitenning: 1.00 Percent

Weathering and elevation Statics to a floating Datum Plane (FDP)

Velocity Analysis

Type: Semblance Plots and
Constant Velocity Stacks
Interval: 2000 M

Surface Consistent Automatic Statics

High Frequency Statics
Window: 600-3600 MS
Dip Limits: +/- 20 MS/24 Traces

FK Filter - On Shot Gaths Random Noise Attenuation

Dip Moveout - Common Offset Plane Kirchoff Constant Velocity

Velocity Analysis

Type: Constant Velocity Stacks
MVP Velocity Analysis
Interval: 500 M

Final NMO Corrections (Referenced to Surface) (FDP)

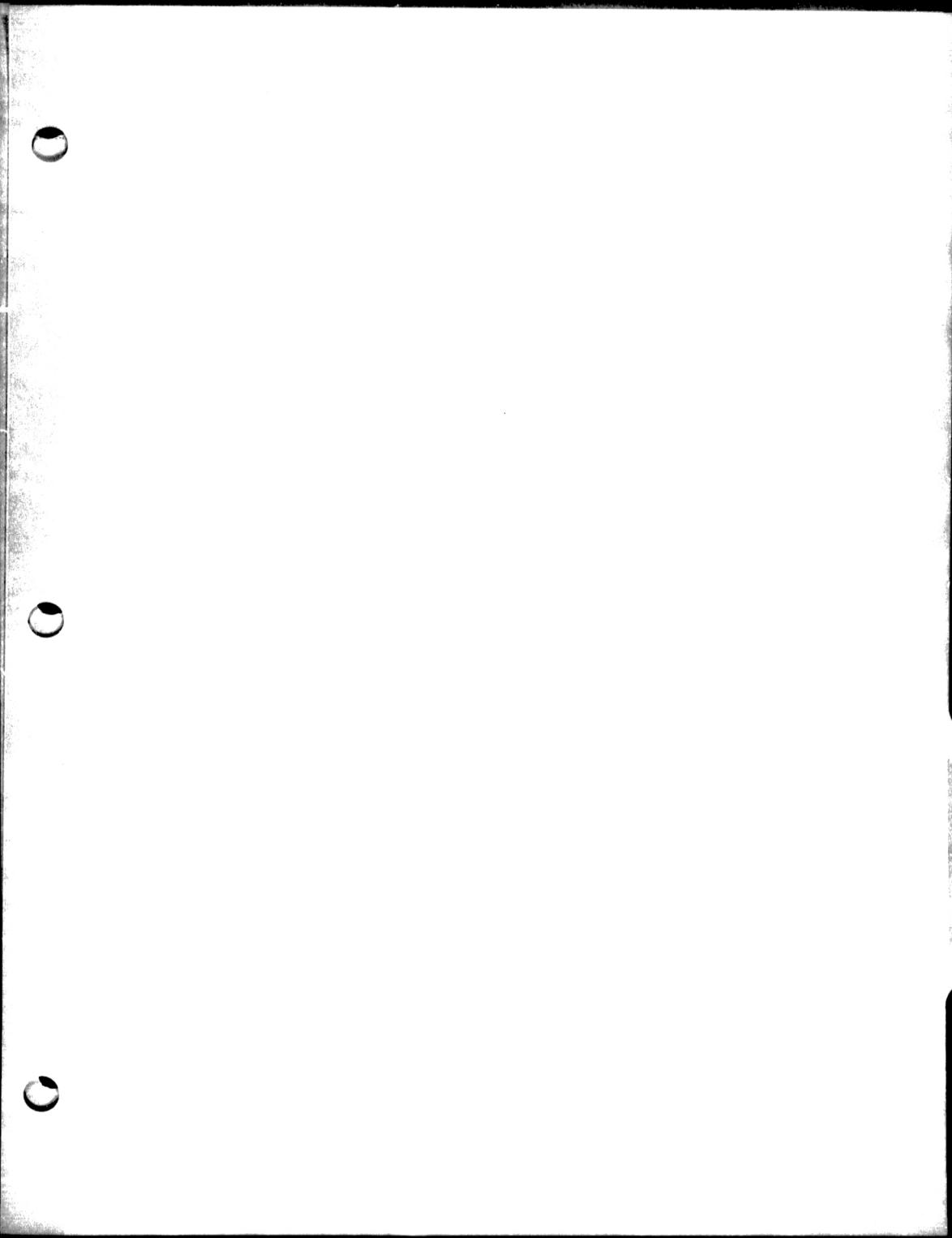
Mutes application from Surface (FDP)
Time (MS) 0 150 350 850
Offset (M) 290 450 1010
3010
Taper 32 MS

Stack: 7500 Percent
Statics to Fixed Datum
Structural Datum: 500 M ASL
Replacement Velocity: 4000 M/Sec

Wave Equation Migration
Space-Frequency Domain 90% Stack
Vels

Filter: Zero Phase Bandpass
08/12 - 65/75 Hz

Equalization (Dynamic):
300 MS Window, 50 Percent Overlap
0-900 MS
700 MS Window, 50 Percent Overlap
750-5000 MS



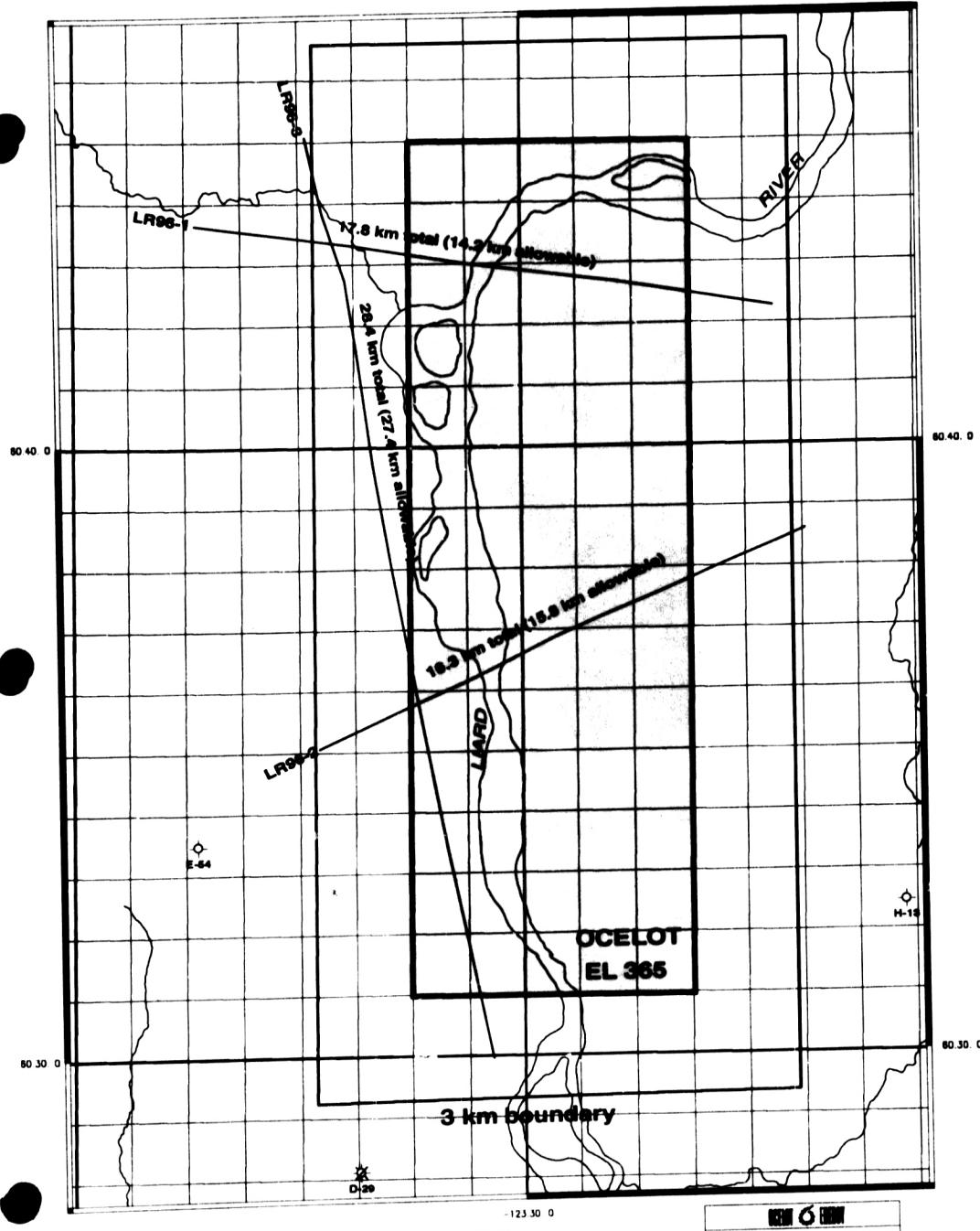
Interpretation

The middle Devonian carbonates constitute the only likely reservoir unit in this area. To identify seismic events, correlations had to be brought into the area from distant wells such as Nelta M-31 and several Arrowhead wells.

The middle Devonian Structure Map is attached as Enclosure #1.

Three leads or prospects were identified on EL 365. The southernmost one is a probable thrust structure in the SW corner of the license which was cut obliquely by line LR 96-3. Without owning an interest in adjacent lands this relatively deep structure would not be worth pursuing further. In the middle of the block another structural trap of low relief was identified at the intersection of lines LR 96-2 and FTL-50. The bulk of this anomaly lies under the Liard River and would be extremely difficult to define any better.

The best prospect on EL 365 was identified last year at the intersection of lines FTL-03 and FTL-50. The new line LR 96-1 shows an apparent extension of this prospect to the North. If this is a continuous structure, then it's apparent absence on the old 6-fold line CCQ-4 must be due to inadequate static control. An interpreted version of the prospect on line LR 96-1 follows as Figure 2. The structure looks anticlinal but contains an apparent thrust fault which barely cuts the middle Devonian. To bring this prospect to a drilling stage at least one more seismic line will have to be shot to confirm northern closure and to establish continuity of the structure in the area around line CCQ-4.



Total km within 3 km of EL 365: 57.4 km

See to 1:150000.

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