#82034mfe

SUMITOMO

MFES LOG BOOK
GYRE 82-11

S/C

U.S. GEOLOGICAL SURVEY
OFFICE OF MARINE GEOLOGY

Woods Hole, Massachusetts
02543

101512

Acoustic monitoring for modules and pavement.

The acoustic monitoring was carried out from 18 to 25-Sept, 82 by using MAES (Multi Frequency Exploration System).

MAES is the system to provide information on the distribution density and size of manganese nodules on the seafloor on a real-time and continuous basis when combined with the acoustic sounding instruments by analysing the acoustic intensities of multi frequencies.

MAES is operated under the following conditions.

- Frequency 27KH, 15KH and 3.5KHZ
- Acoustic sounding instrument

27KHZ & 15KHZ
DATASONICS MODEL DAT-210
Dual frequency Transceiver

3.5KHZ
DATASONICS MODEL SBT-220
Sub-bottom profiler

- Pulse length

27KH & 15KH	5 msec
3.5KH	2 msec

- Transmitting interval
  4 sec (27KHZ, 15KHZ & 3.5KHZ Sync.)

runs

1. log sheet of operation.

18. Sept 10:00 Depat from Morehead city.

19. Sept 8:00 - 9:19 Test run for parameter set.

	Power	Gain	DET	Total Gain
27K	0	05	×10	
15K	-3	15	×3	47dB
3.3K	-10	011	×3	56dB

10:00 - 10:34 Reflacted wave form observation by ADC program.

11:12 - 13:27 Test run after parameter set

	Power	Gain	DET	Total Gain
27K	0	05	×10	
15K	-3	15	×3	47dB
3.3K	-10	011	×3	56dB

15:05 - 15:50 File MF19-01 Profile L1 At loc. 2

	Power	Gain	DET	Total Gain
27K	-3	15	×3	47dB
15K	-3	15	×1	37dB
3.3K	-3	011	×3	56dB

16:35 - 17:17 File MF19-02 Profile L1

	Power	Gain	DET	Total Gain
27K	-3	15	×10	57dB
15K	-3	15	×3	47dB
3.3K	-6	011	×3	56dB

17:22 - 17:51 File MF19-03 Profile L1

	Power	Gain	DET	Total Gain
27K	-3	15	×10	57dB
15K	-3	15	×3	47dB
3.3K	-6	011	×3	56dB

19:35 - 20:48 File MFA 20-01 Profile L1

	Power	Gain	Det	Total Gain
27K	-0	15	×10	57 dB
15K	0	15	×3	47 dB
3.5K	-10	011	×3	56 dB

* 20:23 - 20:24 Misconnection of wire for 3.5KHz.

20. Sept 20:57 - 01:36 File MFA 20-02 Profile L1

	Power	Gain	Det	Total Gain
27K	0	15	×10	57 dB
15K	0	15	×3	47 dB
3.5K	-10	011	×3	56 dB

09:00 - 12:00 Data print out program modification.

13:00 - 16:00 Key in the data of MFA 20-01 to Floppy disk.

21. Sept 02:43 - 05:32 File MFA 21-01 Profile L4

	Power	Gain	Det	Total Gain
27K	0	15	×10	57 dB
15K	0	15	×3	47 dB
3.5K	-10	011	×3	56 dB

06:49 - 10:27 File MFA 21-02 Profile

	Power	Gain	Det	Total Gain
27K	0	15	×10	57 dB
15K	0	15	×3	47 dB
3.5K	-10	18	×10	56 dB

21:00 - 21:27 File MFA 22-01 Profile L6-1

	Power	Gain	Profile	Total Gain
27K	0	15	×10	57 dB
15K	0	15	×3	47 dB
3.5K	-10	18	×10	56 dB

22. Sept. 21:30 - 04:30 File MF 22-02 Profile L6-1

	Power	Gain	DET	Total Gain
27K	0	15	×30	67 dB
15K	0	15	×3	47 dB
3.5K	-10	18	×10	56 dB

06:51 - 10:56 File MF 22-03 Profile L6-2

	Power	Gain	Det	Total Gain
27K	0	15	×30	67 dB
15K	0	15	×3	47 dB
3.5K	-10	18	×10	56 dB

* No data File on discattle.

13:00 - 17:00 Program modification.

20:49 - 21:22 File MF 23-01 Profile L7

	Power	Gain	Det	Total Gain
27K	-3	15	×30	67 dB
15K	-3	15	×3	47 dB
3.5K	-10	18	×10	56 dB

23. Sept. 22:01 - 01:24 File MF 23-02 Profile L7

	Power	Gain	Det	Total Gain
27K	-3	15	×30	67 dB
15K	-3	15	×3	47 dB
3.5K	-10	18	×10	56 dB

10:00 - 17:00 Program modification for 3.5K (SBP) (noise filtering)

17:29 - 20:12 SBP-01 Moving from ST-13 to DVI area. acoustic intensity of SBP measurement.

	DET	Total Gain
3.5KHz	×1/10	

21:02 - 23:14 SBP-02 Moving from ST-13 to DVI area

	DET	Total Gain
3.5KHz	×1/10	

24. Sept. 23:34 - 09:16 File MF24-01 DVI Area

	Power	Gain	Det	Total Gain
27K	-3	12	x10	67 dB
15K	-3	15	x3	47 dB
3.5K	-10	18	x10	56 dB

09:22 - 17:23 . File MF24-02 DVI Area

	Power	Gain	Det	Total Gain
27K	-3	12	x10	67 dB
15K	-3	15	x 3	47 dB
3.5K	-10	18	x10	56 dB

25. Sept 11:00 - 17:00

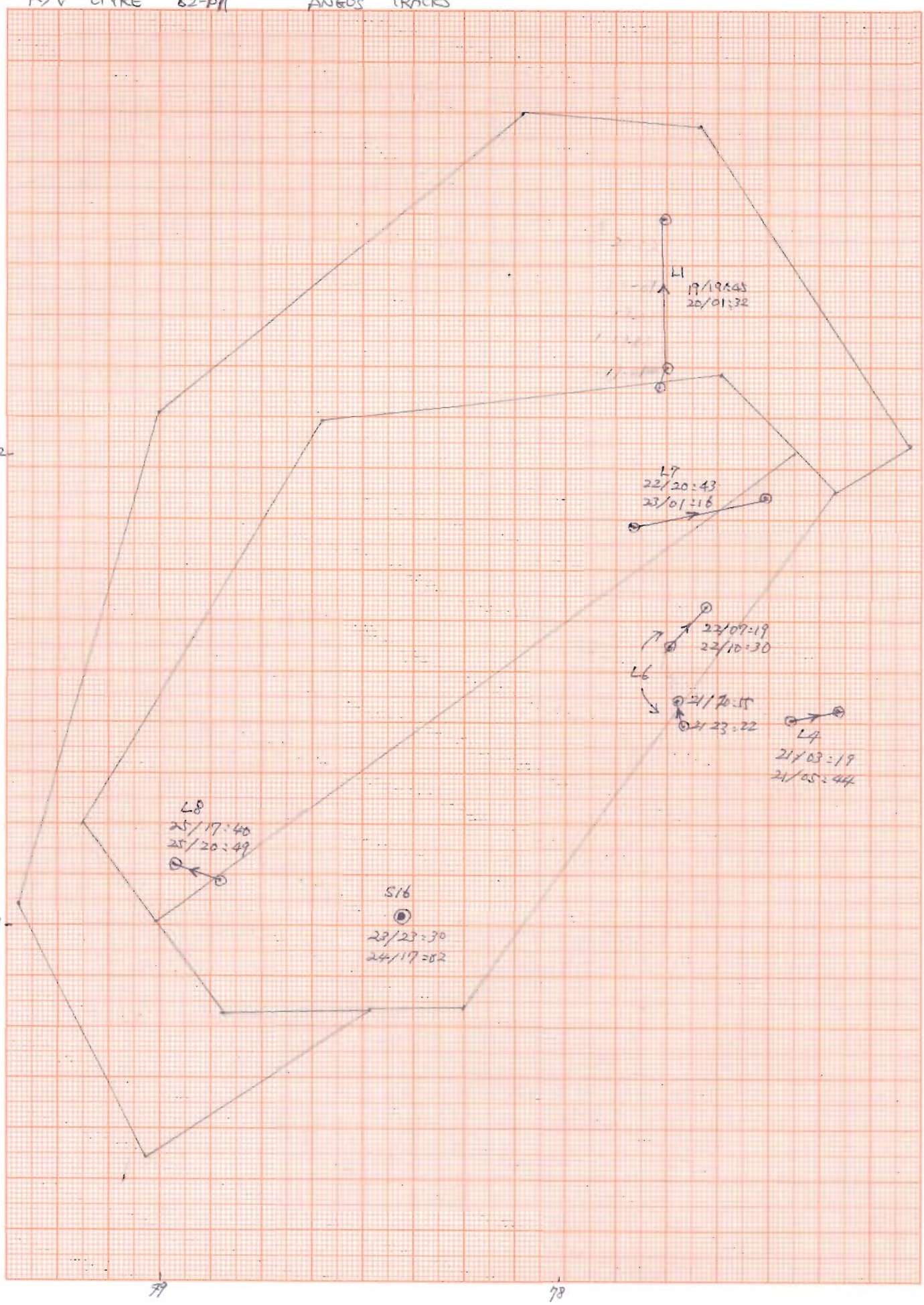
Data correction and data print out.

17:22 - 20:48 File MF25-01 Profile L8

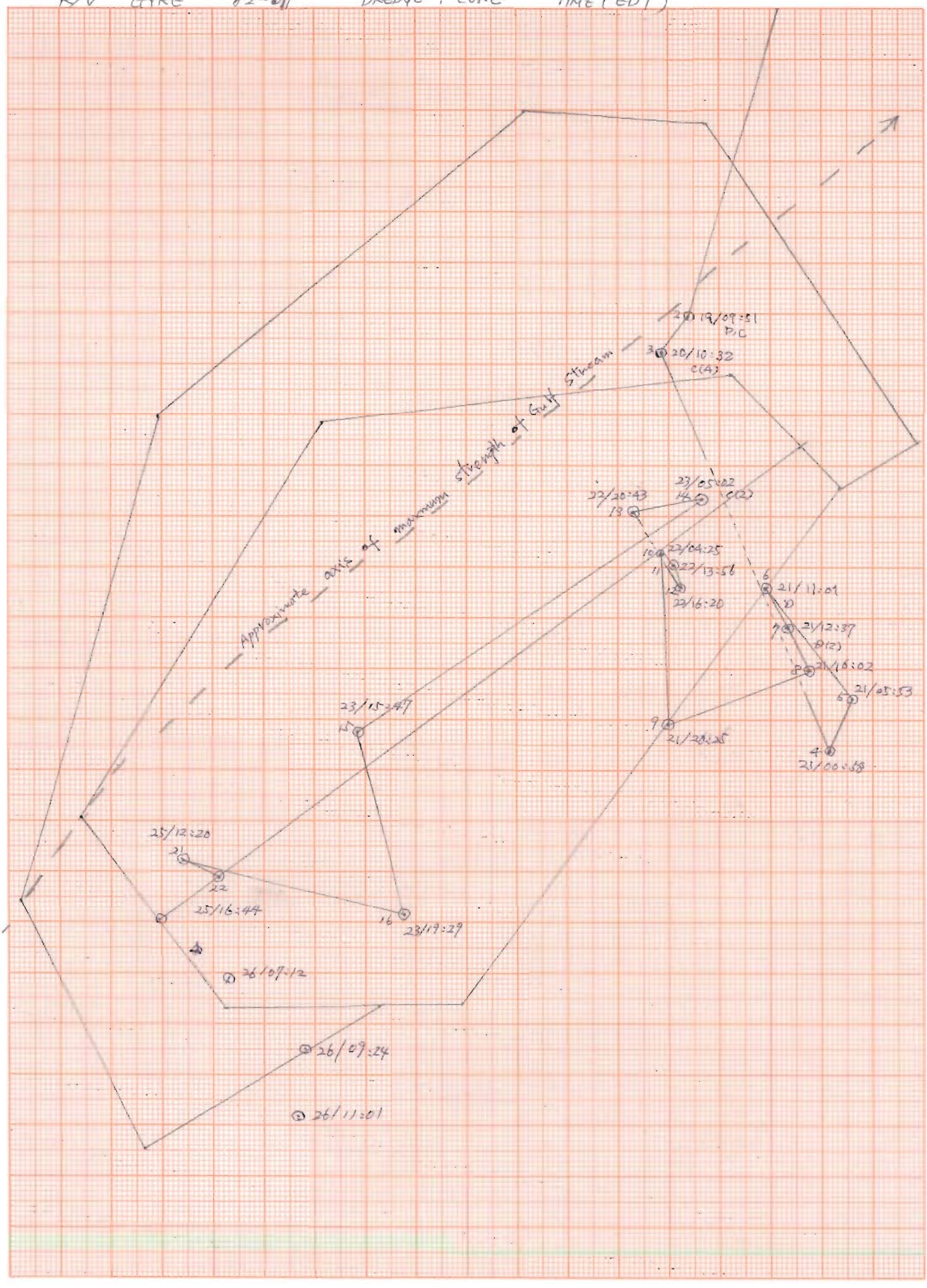
	Power	Gain	Det	Total dB
27K	-3	12	x10	67 dB
15K	-3	15	x3	47 dB
3.5K	-10	18	x10	56 dB

26. Sept 10:00. Recorded data print out.

R/V "GYRE" 82-A1 ANGUS TRACKS



R/V GYRE 82-6A DREDGE . CORE TIME (EDT)



2. Results of monitored data.

A) Acoustic Intensity.

The acoustic intensity of three frequencies was observed every 4 sec and the averaged intensity of 15 readings was printed out to the line printer every one minute.

The listed acoustic intensity is expressed in dB ($1\mu Pa = 0dB$) and has already corrected for attenuation and expansion loss. The total amplifier gain is 67dB, 47dB and 56dB for 27KHz, 15KHz and 3.5KHz respectively.

The results are printed out from GI 19-01 to GI 25-05.

Graph ID	Day	Time (GMT)	Filename
GI 19-01	19. Sept.	19:05 - 19:50	MA 19-01
GI 19-02	19. Sept.	20:35 - 21:17	MA 19-02
GI 19-03	19. Sept.	21:22 - 21:51	MA 19-03
GI 20-01	20. Sept.	23:35 - 00:48	MA 20-01
GI 20-02	20. Sept.	00:57 - 05:36	MA 20-02
GI 21-01	21. Sept	06:43 - 10:32	MA 21-01
GI 21-02	21. Sept	10:49 - 14:27	MA 21-02
GI 22-01	22. Sept	01:00 - 01:27	MA 22-01
GI 22-02	22. Sept	01:30 - 08:30	MA 22-02

GI.

GI 23-01	23. Sept. 00:49 - 01:22	MA 23-01	L7 2
GI 23-02	23. Sept. 02:01 - 05:24	MA 23-02	L7
GI 24-01	24. Sept. 03:34 - 13:16	MA 24-01	DVI
GI 24-02	24 Sept. 13:22 - 21:23	MA 24-02	DVI
GI 25-01	25 Sept 21:22 - 00:48	MA 25-01	L8

B) The synthesized value of 27KHZ, 15KHZ and 3.5KHZ and Ratio of 27KHZ and the synthesized value are calculated every 4 sec and averaged value of 15 data are printed out to the line printer.

The synthesized value and the ratio value are expressed as VECT(1) and VECT(2) and explained by the following formula.

$$VECT(1) = C_1 * (I_{27K} + I_{15K} + I_{3.5K}) / \sqrt{3} + C_2$$

$$VECT(1) = C_3 * I_{27K} / VECT(1)$$

C_1, C_2, C_3 : Constant value

The results of data is printed out from GV19-01 to GV25-01.

The acoustic intensity (0dB = 1Pm) of those graph (GA 19-01 – GA 25-01) is the observed data (not corrected for depth) at the RX amplifier gain of 67 dB, 47 dB and 56 dB (27K, 15K & 3.5KHz).

Graph ID	Day	Time (GMT)	File name
GA 19-01	19 Sept.	19:05 – 19:50	MF 19-01
GA 19-02	19 Sept.	20:35 – 21:17	MF 19-02
GA 19-03	19 "	21:22 – 21:51	MF 19-03
GA 20-01	20 "	23:35 – 00:48	MF 20-01
GA 20-02	20 "	00:57 – 05:36	MF 20-02
GA 21-01	21 "	06:43 – 10:32	MF 21-01
GA 21-02	21 "	10:49 – 14:27	MF 21-02
GA 22-01	22 "	01:00 – 01:27	MF 22-01
GA 22-02	22 "	01:30 – 08:30	MF 22-02
GA 23-01	23 "	00:49 – 01:22	MF 23-01
GA 23-02	23 "	02:01 – 05:24	MF 23-02
GA 24-01	24 "	03:34 – 13:16	MF 24-01
GA 24-02	24 "	13:22 – 21:23	MF 24-02
GA 25-01	25 "	21:22 – 00:48	MF 25-01

C) Digital recorded data.

The observed data was recorded to "FLOPPY DISK" initialized by DEC* Format according to the following Form.

Variable name	Format	Note
HH, MM, SS	3I2	Observed hour, minutes & sec.
I27	F6.1	Acoustic intensity (27KHz) } No correction.
I15	F6.1	" (15KHz) } No correction.
I35	F6.1	" (3.5KHz) } No correction.
VEC1	F5.1	Vector 1.
VEC2	F5.1	Vector 2.

MEMO A6 MEMO (6 characters)
DEPTH F6.0 Depth (Unit=m, averaged)

File Directory and coments.

File name	Total Gain (27K)	(15K)	(3.5K)	DATE.
MF1901.DAT	-20db	-10db	0dB	EDT
MF1902.DAT	-10db	0	0	EDT
MF1903.DAT	-10db	0	0	EDT
MF2001.DAT	-10dB	0	0	GMT
MF2002.DAT	-10dB	0	0	GMT
MF2101.DAT	-10dB	0	0	GMT
MF2102.DAT	-10dB	0	0	GMT
MF2201.DAT	-10dB	0	0	GMT
MF2202.DAT	-10db	0	0	GMT
MF2301.DAT	0	0	0	GMT
MF2302.DAT	0	0	0	GMT
MF2401.DAT	0	0	0	GMT
MF2402.DAT	0	0	0	GMT
MF2501.DAT	0	0	0	GMT

NB.1 27K 0 = 67dB
15K 0 = 47dB
3.5K 0 = 56dB

NB.2 The transmitting power attenuation is not taken into correction, because of the cabitation caused by small surface of transducer.

3. Data Analysis.

The nodules at Pacific Ocean lies on the bottom which is mainly consist of soft sediment and more than 70 meters of thickness. On the other hand nodules at Blake plateau lies on the hard bottom. Therefore it is very difficult to obtain the coverage (Kg/m^2) and size directly by the same method applied at Pacific Ocean. Detail data analysis is necessary for obtaining the coverage and size information of Blake plateau nodules.

From the synthesized intensity of three frequencies (VECTOR 1), the type of bottom such as rock and/or sediment can be roughly discriminable as follows.

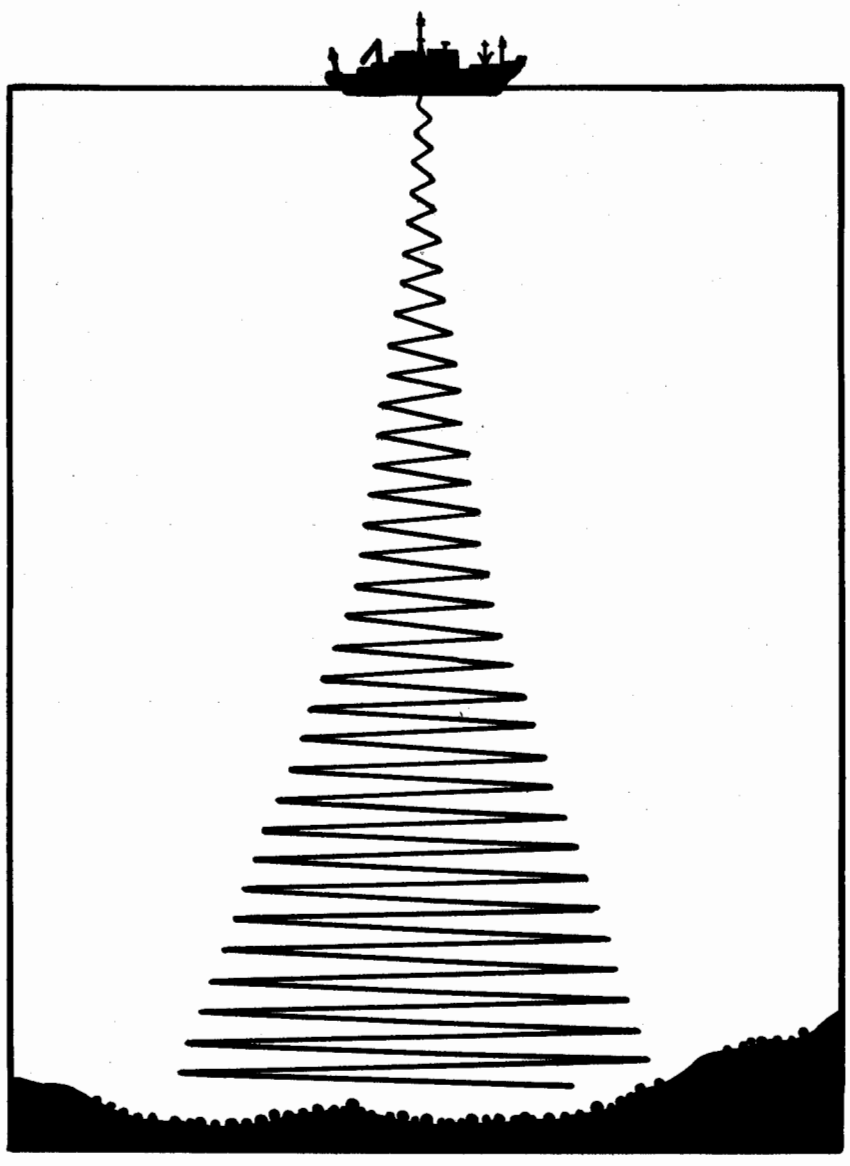
Hard bottom (Pavement) > 35 dB
Sediment < 20 dB
(Vector (1), relative Intensity)

We don't have enough time to analyse the data, and further analysis is necessary for obtaining the coverage and size of nodules by multi frequency explaration system.

M F E S

MULTI–FREQUENCY EXPLORATION SYSTEM

General Description



SUMITOMO METAL MINING CO., LTD.

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1. Introduction

The Multi-Frequency Exploration System provides information on the distribution density and size of manganese nodules on the seafloor on a real-time and continuous basis when combined with the acoustic sounding instruments such as echo-sounders and the sub-bottom profiler, with which on ocean research vessels are commonly equipped.

The system design was completed in 1978. The first assembly of the model SM-100A was installed on board the Hakurei Maru No. 2 owned by the Metal Mining Agency of Japan, which was designed exclusively for the exploration of manganese nodules and put into service in August 1980. The total operating time of the equipment delivered to the MMAJ reached 1,600 hours without any trouble by the end of December 1980. It is anticipated to exceed 6,000 hours by the end of 1981.

The system is one of the most advanced for surveying manganese nodules on the deep sea bottom.

2. Applicability

The frequency of acoustic sounding instruments such as echo sounders and the sub-bottom profiler should theoretically be in the following ranges in order to obtain the best quality, since the target nodule size is considered to be from several to over ten centimeters in diameter.

f_1 : 3 ——— 5 KHz
f_2 : 8 ——— 15 KHz
f_3 : 25 ——— 35 KHz

Frequencies other than the above are, of course, able to provide practically sufficient information. In case of prospecting, combination of two frequencies is also useful.
SM-100A can be combined with any type of acoustic sounding instruments with general specification, provided that the output signals of waves received from them are linearly amplified and controlled to avoid saturation.

3. System Description

Input signals to MFES comprise transmitted waves from acoustic sounding instruments and sound pressure signals of received waves.

Upon receiving the trigger signals of transmitted waves, the window is opened for a previously set period in order to receive reflected waves. Then the system performs processing of the received reflected waves. Analog signals of received waves can be monitored with level meter (optional). In digital processing, water depth correction is done based on the travel time of received signals. Calibration to any change of the sound pressure of transmitted waves can be made by using the stored transmitted waves information. The system is designed to perform correlation processing between transmitted and received signals of f_1 component when necessary. After these operations, the operation program is executed to calculate the distribution density and size of nodules. The distribution density and size of nodules are displayed on the printer along with other information (hour, minute, average depth, and amplitude). These can be put out as digital information. The name of profile, longitude, latitude, date, hour, and minute are displayed on the printer by manual input through CRT display keyboard when necessary.

The system has a program development function for data processing and operation and a function to diagnose system operation. The system also has a function to analyze reflected waves from the sea bottom to determine some of the physical properties of the surface of the sea bottom. Utilizing this function, model SM-100A is designed so that discrimination is made between nodules and exposed rocks. "Rock?" appears both on the CRT display and on the line printer when there is reflection from exposed rocks.

4. Features

MFES model SM-100A has the following features:

(1) Highly effective exploration is possible as it can be operated at normal ship speeds (10∿12 knots).

(2) Operating water depth is allowed to the extent which the customer-owned acoustic sounding instruments can perform.

(3) Substantial savings of money and time an exploration cruises are possible by considering adequate profile and sampling pattern since the variation of metal contents of manganese nodules is said to be much smaller than that of the distribution density.

(4) Efficiency is 3∿4 times higher than the deep sea TV system. Accidents such as cable cutting or collisions with obstacles may occur on towing the TV system. With MFES there is no such possibility.

(5) It can discriminate between nodules and exposed rocks automatically. Conditions on the sea bottom are known in greater detail by adding this information to SBP records. It enables the preparation of detailed maps for collecting nodules and also the investigation of the origin of manganese nodules.

(6) The print out format is easy to see. Since the hour, minute, and average depth are also printed out simultaneously, these can be easily plotted on the profile map drawn by the customer.

(7) A daily log can be prepared within the remark space given in the printer output column by manually inputing short memorandum (e.g. CHANGE P or END P for change of profile or end of profile) through the CRT display keyboard (up to eight characters per column).

(8) More detailed real time data processing on board is made possible by combining the system with a computer enstalled on the vessel. This is also possible by making use of the system's own function to develop the program.

(9) The system is easily installed and requires minimum space.

(10) Operation of the system is easy and simple. No special operator is required exclusively for operation. It can be operated even though the operator is simultaneously in charge of other equipment.

(11) Maintenance and inspection are quite easy.

(12) All components of the system are composed of standard products.

5. Functional Description

5.1 Subsystems

The Multi-Frequency Exploration System consists of the following subsystems.

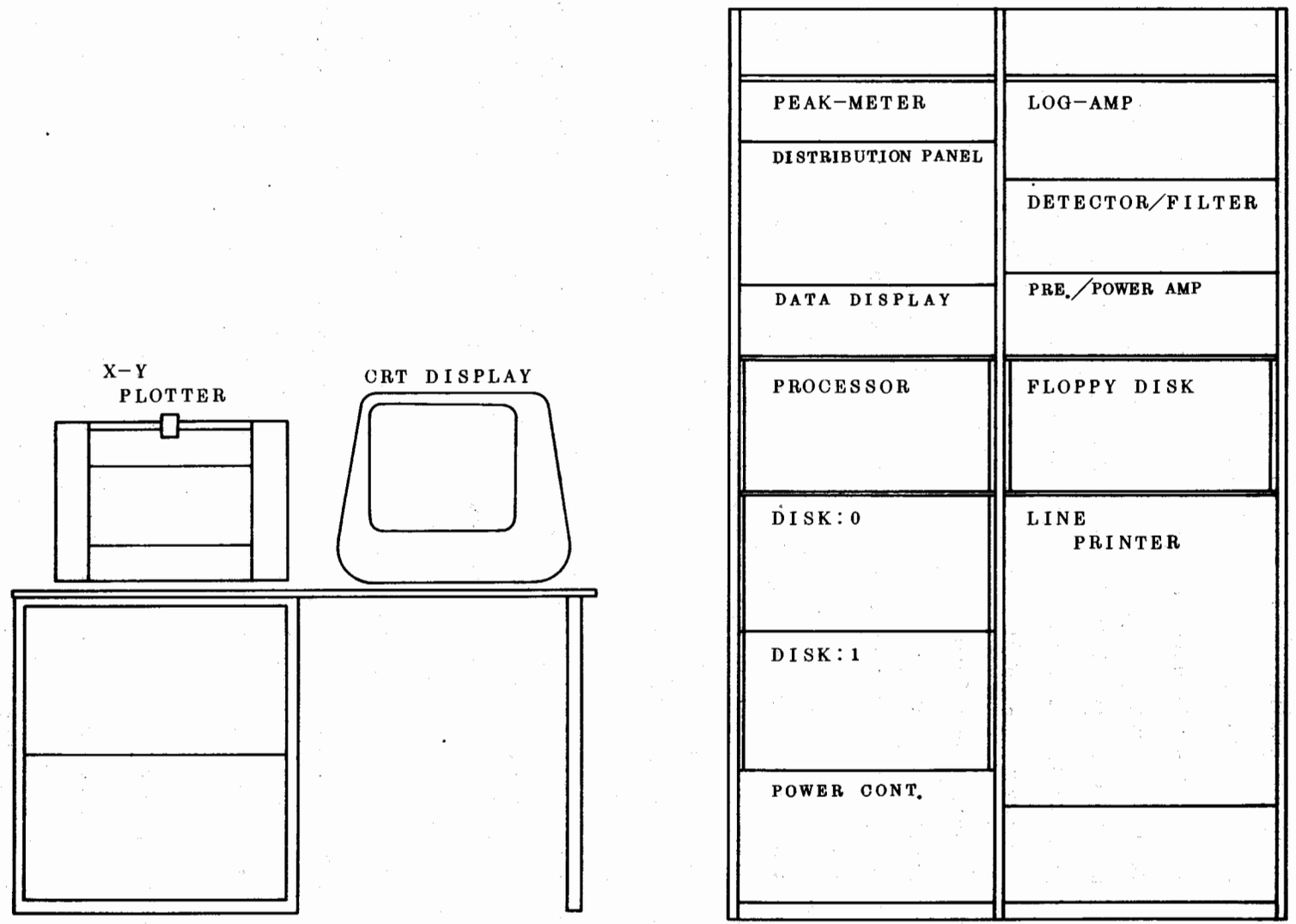

Fig. 5-1 LAYOUT OF SYSTEM COMPONENTS

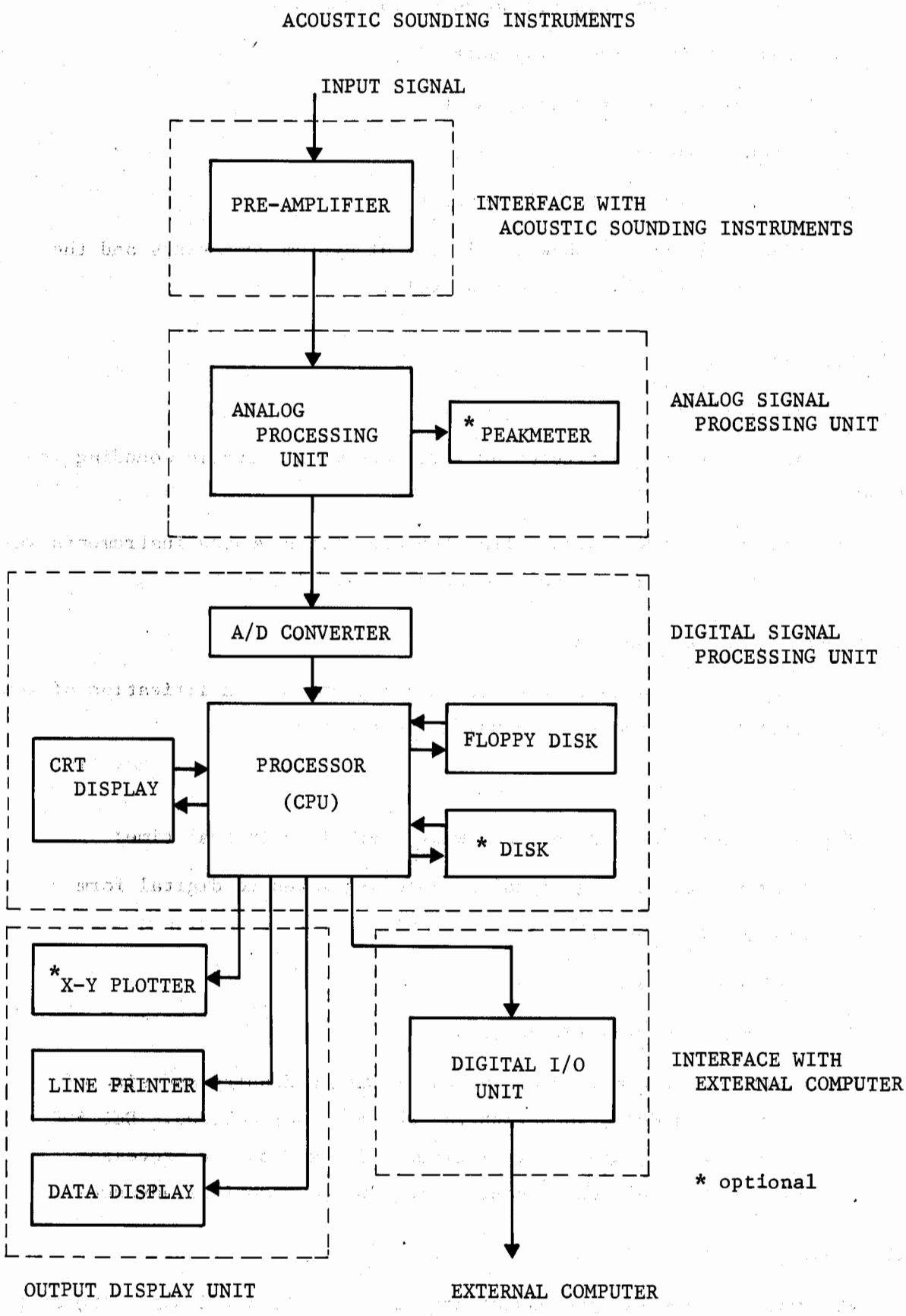

Fig. 5-2 SYSTEM BLOCK DIAGRAM

a. Interface with acoustic sounding instruments.

b. Analog signal processing unit.

c. Digital signal processing unit.

d. Output display unit.

e. Interface with external computer.

Figs. 5-1 and 5-2 show the layout of system components and the system block diagram, respectively.

5.2 Standard Components

5.2.1 Preamplifier

The preamplifier constitutes an interface with acoustic sounding instruments.

It adjusts the input signal from the acoustic sounding instruments which is converted to a voltage signal, to adequate levels.

5.2.2 Analog Processing Unit

It performs filtration, detection and logarithmic amplification of sound pressure signals from acoustic sounding instruments.

5.2.3 Processor

The processor performs the following operations in real time:

a. Converts the analog signal of received waves to digital form

b. Arithmetic operation

c. Memory management

d. Control of peripheral devices

e. Output of information on the distribution density and size of manganese nodules to peripheral and external devices. DEC PDP-11/34 general purpose mini-computer is used as the processor, but may be replaced without notice due to technical advances

5.2.4 Floppy Disk

Programs for on-line processing are stored in floppy disks. The system is usually driven on an on-line basis by floppy disks.

5.2.5 CRT Display

Data is displayed on the CRT screen for monitoring purposes. Data can also be entered manually by keyboard operation.

5.2.6 Line Printer

The line printer provides tables of data including the hour, minute, average depth, received wave sound pressure amplitude, distribution density and size of nodules at a predetermined interval of time. It also provides profiles of distribution density and size of nodules.

5.2.7 Digital I/O Unit and Data Display

The unit transfers necessary information to the external computer.

5.3 Optional Equipment

The following equipment may be added as options.

a. Disk

b. X-Y plotter

c. Peak meter

6. Operating Procedure

Usually, the system performs its operation automatically after the necessary constants are set when starting. However, resetting of the window level or trigger level may be required when the topography of the sea bottom changes greatly or reflected waves are too weak, respectively.

Operation shall be in the following sequence.

a. Turn on the power supply to the system.

b. Set the system floppy.

c. Bootstrap shall be done by the processor.

d. Enter "date" "hour, minute and second" through the keyboard the terminal.

e. "R MFES" is keyed in.

The system program of MFES is started by the above procedures. Operation thereafter proceeds according to instructions appearing on the CRT screen.

f. Change constants when necessary. There are forty four (44) constants and these are already set when the system is delivered.

g. Enter the data of water depth. The name of profile, latitude and longitude shall be keyed in when necessary.

h. Key in the type of input signals and output devices.
The initial conditions are already set, but must be varied when necessary.
Procedures for starting are completed by the above.
A message "HAVE YOU ALL FINISHED KEY IN?" (Y,N) appears on the CRT.
Key in "Y (YES) RET" to start the system.