BAB V

PENUTUP

5.1 KESIMPULAN

Sistem multibeam yang dikembangkan pertama kali pada tahun 1970-an oleh General Instrument Corp, sampai saat sekarang telah mengalami pembaharuan sehingga kemampuannyapun lebih baik dari generasi multibeam sebelumnya. Dari hasil konsultasi, diskusi serta wawancara dengan pihak-pihak yang terlibat dalam uji coba sistem multibeam echosounder Simrad EM – 950, Simrad EM – 1000 dan Elac Bottomchart, dapat ditarik beberapa kesimpulan yaitu :

1. Sistem multibeam yang mempunyai sudut cakupan yang lebar antara 60° sampai 150° untuk cakupan yang normal. Dengan lebar sudut cakupan ini, lebar daerah yang tercakup pada satu kali sounding adalah antara 3,5 sampai dengan 7,4 kali kedalaman sehingga akan dapat lebih mempercepat pekerjaan.
2. Untuk setiap perubahan kedalaman laut, multibeam khususnya multibeam echosounder Simrad EM – 950, Simrad EM – 1000 dan Elac Bottomchart, dapat merubah lebar sudut cakupan secara otomatis

sehingga sinyal yang dipantulkan kembali oleh dasar laut akan maksimal.

3. Kemampuan sistem multibeam echosounder yang telah terpasang pada kapal riset Baruna Jaya dalam melakukan survei pada laut dalam maupun laut dangkal yaitu pada kedalaman 3 m sampai 2500 m, hal ini tergantung dari type-type multibeam echosounder yang dipergunakan.
4. Dengan kemampuan dan kelebihan diatas, sistem multibeam dapat digunakan dalam :
   - Pemetaan dasar laut untuk keperluan navigasi
   - Survey rekayasa pada daerah pantai atau perairan dangkal
   - Pendataan daerah Zone Ekonomi Eklusive (ZEE)
   - Eksploitasi dan eksplorasi lepas pantai
   - Penyelidikan dibidang geologi dan geofisik kelautan
   - Penentuan rute kabel dan pipa dasar laut
   - Pencarian kapal tenggelam
   - Dll.
5. Untuk aplikasi di Indonesia multibeam echosounder Simrad EM – 950 yang hanya mempunyai kemampuan pengukuran kedalaman hingga 300 m, dapat dioperasikan di wilayah Indonesia bagian barat. Sedangkan Multibeam echosounder simrad EM -1000 mempunyai kemampuan pengukuran hingga kedalaman 1000 m, dapat dioperasikan pada daerah Indonesia bagian Timur. Multibeam Elac

Bottomchart mempunyai kemampuan pengukuran kedalaman antara 350 m sampai 2500 m, dapat dioperasikan di wilayah Indonesia bagian Barat dan Timur (seperti terlihat pengembangannya pada *grafik 4.1*).

5.2 SARAN - SARAN

1. Karena teknologi multibeam echosounder tergolong teknologi baru, maka perlu direncanakan alih teknologi dilingkungan instansi pemerintah maupun swasta yang berkompeten dibidang kelautan.
2. Perlu adanya kursus atau pelatihan serta seminar tentang sistem multibeam echosounder guna mempercepat alih teknologi tersebut.
3. Karena harganya yang relatif mahal serta suku cadang yang sulit didapat maka perlu adanya manajemen pemeliharaan dan pengoperasian yang baik.

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LAMPIRAN A

Spesifikasi Alat Sistem Multibeam Simrad EM - 950

4. COMPUTERS AND EXTERNAL INTERFACES

Electronics cabinet/Transceiver unit

Technology:

- Custom hybrid transmitter, amplifiers and preamplifiers
- Beamformer and signal processing boards based on bitslice processors
- Software storage on EPROMs

Available interfaces:

Sea surface sound velocity probe (Meerestechnik OTS)	RS-232
Heading sensor (gyrocompass)	Synchro RS-232 Analogue
Roll and pitch	Synchro Analogue
Heave	Optocoupler (active on)
Blanking in	Open collector (active low)
Blanking out	Open collector (active low)
Receive active	

Note

Synchro format is 1:1, 400 Hz, 26 or 115 V reference.

Operator Unit

Processor Intel 80486	
Software storage	5.25 inch floppy disk
Display	Colour VGA
Interfaces:	
Data out	Ethernet / RS-232
External clock	RS-232
Positioning system	RS-232
Sound velocity profile probe	RS-232

Bottom Detector Unit

Processor Intel 80486	
Software storage	5.25 inch floppy disk
Display	Optional VGA
External synchronization:	
Transmit Enable input	Serial line CTS
Transmit Ready output	Serial line RTS

Quality Assurance Unit

Processor Intel 80486	
Software storage	5.25" floppy disk
Display	20" colour VGA
Graphic printer interface	Centronics

Sonar Imaging Unit

Processor, (Sonar Imaging)	Intel 80486
Software storage	5.25" floppy disk
Display	20" colour VGA
Recorder interface	Centronics

UNIVERSITAS DARMAPERSADA

5. PERFORMANCE SPECIFICATIONS

Transducer assembly

Number of elements	640 configured as 128 staves
Number of cables	8 (16 coaxial cables in each)
Type of elements	Rectangular Ceramic
Stave sensitivity	-190 dB/V re 1 mPA
Impedance	60 ohm resistive
Frequency 95 kHz	
Bandwidth	10 kHz

Transmitter

Number of channels	128
Maximum power output per channel	50 W
Frequency	95 kHz
Total power output (electrical)	6 kW
Reduced power	-10 dB or -20 dB
Source level	224 dB
Pulse length	0.2 ms
Roll stabilization	
Electronically for roll	Within ±15°
Beamwidth:	
Fore-and-aft	3.3°
Athwartship	128-190°
Side lobes <-20 dB	

Receiver

Number of channels	128
Bandwidth (analogue)	5 kHz
Gain control:	
Programmable Time Varied Gain (TVG)	60 dB
Fixed gain reduction	0 to 30 dB in 6 dB steps
Maximum total gain	115 dB
Range sample rate	15 cm
Number of beams per ping	60
Beamwidth:	
Fore-and-aft	3.3°
Athwartships	3.3°
Side lobes:	
Fore-and-aft	<-18 dB
Athwartships	<-22 dB
Roll stabilization:	
Electronically for roll	±15°

Main system specifications:

Transducer:	Size:	400 x 900 mm
	Weight:	130/95 kg (in air/water)
	Shape:	Cylinder segment
	Number of staves:	128
Transmission:	Number of transmitters:	128
	Total peak power:	4.5 kW
	Frequency:	95 kHz
	Pulse length:	0.2, 0.7 and 2.0 msec
	Source level:	225 dB
	Max. ping rate:	4 pulses/second
Reception:	Number of amplifiers:	128
	TVG:	Digitally controlled
	A/D conversion:	12-bit quadrature sampling
	Range resolution:	15 or 30 cm
	Depth resolution:	2 cm
Beamforming:	Equidistant and equiangle spacing of soundings	
	Shallow mode (3-200 m):	120 beams over 2 pings
	Sounding spacing:	6.3%, 4.6% or 3.4% or 1.3% of depth or 1.25°
	Sector covered:	150°, 140°, 128° or 75°
	Medium mode (200-600 m):	96 beams over 2 pings
	Sounding spacing:	3.6%, 2.7% or 2.0% of depth or 1.25°
	Sector covered:	120°, 105° or 88°
	Deep mode (600-1000+ m):	*48 beams per ping*
	Sounding spacing:	3.0% of depth or 1.25°
	Sector covered:	70° or 60°
	Embankment modes:	
	Channel	±95°
	Port bank	-75° to +95°
	Starboard bank	-95° to +75°
	Water depth	0 - 100 m
Hull unit:	Optional, retractable transducer, pitch stabilized. Max 10 knots survey speed.	
	Required space: 980 x 630 x 3130 mm (WxLxH)	
	Weight: 560 kg	

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N-3191 Horten
Norway

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SIMRAD

LAMPIRAN B

Spesifikasi Alat Sistem Multibeam Simrad EM - 1000

EM 1000
TECHNICAL SPECIFICATIONS

857-130068 // 046

Note !

This is a standard EM 1000 document. It may include technical specifications on equipment not included in your delivery. Please disregard when not applicable.

1. POWER SUPPLY SPECIFICATIONS

Mains voltage	230 Vac ±15% 1-phase (47 to 63 Hz) 230/380/440 Vac 3-phase for hull unit

One single phase supply is required for the sonar room and one for the survey room, each protected with 16 A slow-blow fuses. The hull unit requires a 3-phase supply protected with 16 A slow-blow fuses.

Acceptable transients:

Short time (max 2 sec)	±25%, 42 - 69 Hz
Spikes (max 50ms)	< 1000 V

Power interrupts:

Backup memory implemented in Operator Unit. Menu settings and sound velocity profile are stored in backup memory so operation can continue after power interruption. However, system must be manually restarted.

Overall power requirements (maximum):

Operator Unit console	230 Vac 500 VA
Quality Assurance Unit	230 Vac 300 VA
Sonar Imaging Unit	230 Vac 300 VA
Track Plotter (HP Draftpro)	230 Vac 95 VA
PaintJet Printer (HP)	230 Vac 20 VA
Grey-scale recorder (Dowty 85/195)	230 Vac 250 VA
Transceiver Unit	230 Vac 460 VA
Hull Unit	230/380/440 Vac 3-phase, 1100 VA
Pitch servo	400 VA
Hoisting	700 VA

ENVIRONMENTAL SPECIFICATIONS

Standards:	
EMC Noise emission	EN55022 (Class A)
EMC Noise immunity, voltage spikes	EN55101
Vibration	MIL.STD 167-1
Shock	MIL.STD 4141, 4142
Environment:	
Sonar room temperature	0° to 55°C
Operations room temperature	0° to 40°C
Storage temperature	-30° to +70°C
Sonar room humidity	Up to 96% (Non-condensing)
Operations room humidity	Up to 95% (Non-condensing)
Vibration:	
4 - 15 Hz	± 0.76 mm
16 - 25 Hz	± 0.51 mm
26 - 33 Hz	± 0.25 mm
34 - 40 Hz	± 0.13 mm
41 - 50 Hz	± 0.076 mm
Shock:	
Electronic cabinets w/shock absorbers	15g half period sine
Duration	6 ms

Note

To extend the lifetime of the equipment, the sonar room should be equipped with sufficient ventilation and the temperature should not be too high (i.e. > 30°) for long periods of time.

3. PHYSICAL DIMENSIONS

Note

All dimensions are given excluding mounting arrangements such as shock absorbers etc. Normal arrangements for these, including dimensions, are shown in the drawings in the drawing file. Note also that when fitting the units, due space must be provided for the cables.

Operator console (Single display)

Dimensions:

Height	1170 mm
Width	540 mm
Depth	1075 mm
Weight	150 kg
Material	Al

Dual console (dual displays)

Dimensions:

Height	1779 mm
Width	540 mm
Depth	1075 mm
Weight	212 kg
Material	Al

HP Draftpro pen plotter

Dimensions:

Height	1240 mm
Width (A1/A0)	1161/1445 mm
Depth	686 mm
Weight	47-53 kg

HP Draftmaster pen plotter

Dimensions:

Height	1346 mm
Width	1194 mm
Depth	508 mm
Weight (model dependent)	71 to 81 kg

HP Paintjet colour printer

Dimensions:	
Height	98 mm
Width	442 mm
Depth	302 mm
Weight	5 kg

Dowty 85 grey-scale recorder

Dimensions:	
Height	132 mm
Width	432 mm
Depth	400 mm
Weight	15 kg

Dowty 195 grey-scale recorder

Dimensions:	
Height	176 mm
Width	660 mm
Depth	508 mm
Weight	32 kg

Transceiver unit

With servo amplifier rack for hull unit:

Dimensions:	
Height	1758 mm + 45 mm (lifting bolts)
Width	585 mm
Depth	525 mm
Weight	200 kg
Material	steel

Without servo amplifier rack

Dimensions:	
Height	1110 mm + 45 mm (lifting bolts)
Width	585 mm
Depth	516 mm
Weight	160 kg
Material	steel

Hull unit

Weight	Approximately 1 ton
Height above trunk	2150 mm
Distance raise/lower	820 mm

Transducer

Dimensions:

Height	398 mm
Width	887 mm
Length	473 mm
Weight in air	130 kg
Length of cables	12.5 m

Relay unit

Dimensions:

Height	500 mm
Width	400 mm
Depth	250 mm
Weight	15.5 kg
Material	steel

Local/Remote control unit

Dimensions:

Height	241 mm
Width	151 mm
Depth	114 mm
Weight	1.5 kg
Material	steel

Junction box (Synchronization)

Dimensions:

Height	215 mm
Width	270 mm
Depth	120 mm
Weight	4.5 kg
Material	steel

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COMPUTERS AND EXTERNAL INTERFACES

TRANSCEIVER UNIT

Technology:

- Custom hybrid transmitter, amplifiers and preamplifiers
- Beamformer and signal processing boards based on bitslice processors
- Software storage on EPROMs

Interfaces:

Sea surface temperature probe (PT-100)	RS-232
Sea surface sound velocity probe (Meerestechnik OTS)	RS-232
Heading sensor (gyrocompass)	Synchro
Roll and pitch	RS-232 Analogue
Heave	Synchro
Blanking in	Analogue
Blanking out	Optocoupler (active on)
Receive active	Open collector (active low)
	Open collector (active low)

Note

Synchro format is 1:1, 400 Hz, 26 or 115 V reference.

OPERATOR UNIT

Processor	Intel 80486
Software storage	5.25 inch floppy disk
Data storage (optional)	Mountain Optech SEL-2 optical disk
Display	20" colour VGA

Interfaces:

Data out	Ethernet
	RS-232
External clock	RS-232
Positioning system	RS-232
Sound velocity profile probe	RS-232
Track plotter	RS-232
Echogram recorder	Centronics

4.3. BOTTOM DETECTOR UNIT

Processor	Intel 80486
Software storage	5.25 inch floppy disk
Display	Optional 14" VGA
External synchronization:	
Transmit Enable input	Serial line CTS
Transmit Ready output	Serial line RTS

4.4. QUALITY ASSURANCE UNIT

Processor	Intel 80486
Software storage	5.25" floppy disk
Display	20" colour VGA
Graphic printer interface	Centronics

4.5. SONAR IMAGING UNIT

Processor, (Sonar Imaging)	Intel 80486
Software storage	5.25" floppy disk
Display	20" colour VGA
Recorder interface	Centronics

5. PERFORMANCE SPECIFICATIONS

5.1. HULL UNIT

Stabilization	Mechanical compensation for pitch (±12°)

5.2. TRANSDUCER ASSEMBLY

Number of elements	640 configured as 128 staves
Number of cables	8 (16 coaxial cables in each)
Type of elements	Rectangular Ceramic
Stave sensitivity	-190 dB/V re 1 mPA
Impedance	60 ohm resistive
Frequency	95 kHz
Bandwidth	10 kHz

5.3. TRANSMITTER

Number of channels	12
Maximum power output per channel	50 W
Frequency	95 kHz

Total power output (electrical)	6 kW
Reduced power	-10 dB or -20 dB
Source level:	
Shallow	224 dB
Medium	225 dB
Deep	226 dB
Pulse length:	
Shallow	0.2 ms
Medium	0.7 ms
Deep	2 ms
Roll stabilization (electronically)	Within ±15°
Beamwidth:	
Fore-and-aft	3.3°
Athwartship:	
Shallow	150° or 190°
Medium	120°
Deep	60 or 70°
Side lobes	<-20 dB

3.4. RECEIVER

Number of channels	128
Bandwidth (analogue)	5 kHz
Gain control:	
Programmable Time Varied Gain (TVG)	60 dB
Fixed gain reduction	0 to 30 dB in 6 dB steps
Maximum total gain	115 dB
Range sample rate:	
Shallow	15 cm
Medium	30 cm
Deep	30 cm
Number of beams per ping	
Shallow	60
Medium and deep	48
Beamwidth:	
Fore-and-aft	3.3°
Athwartships	3.3°

Side lobes:	
Fore-and-aft	<-18 dB
Athwartships	<-22 dB
Roll stabilization:	
Electronically for roll	±15°

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LAMPIRAN C

Spesifikasi Alat Sistem Multibeam Elac Bottomchart

SUMMARY OF SYSTEM FEATURES

- o Wide horizontal scan areas covered with 56 adjacent beams.
- o Very high resolution, achieved by narrow beam width and an efficient sidelobe suppression due to directional transmitting and receiving.
- o High operating frequency giving clearly defined sea bed features.
- o Two compact transducer arrays, for ease of installation, with an acoustic source level of up to 234 db/mPascal/m @ 50 kHz (220 db/mPascal/m @ 180 kHz) and a transmitter power output of 2 X 600 W @ 180 kHz (2 X 3500 W @ 50 kHz).
- o Dynamic ship's motion compensation for roll, pitch and heave, yaw and ship's speed
- o Continuous real–time hydrographic bottom chart output on a high–resolution graphic printer.
- o On–line storage of raw and pre–processed data for post–processing using the BOTTOMCHART high–performance 32–bit processor or a separate post–processing system.
- o Operationally proven hard and software.
- o Interface to sound velocity profiling system
- o Analog output selectable
- o Multiprocessor design
- o Interfaces for external system check

1.2 System Description

1.2.1 System Configuration

The BOTTOMCHART system is made up of two main sub–systems :

- o The acoustic sub–system
- o The data processing sub–system

Figure 1–1 shows a block diagram of the system. The acoustic sub–system is made up of the following units :

- o 2 x Ultra–sonic Transducer Arrays (LSE 237 @ 50 kHz system)
  (LSE 296 @ 180 kHz system)
- o 1 x Transmit/Receive Unit SEE 28
- o 1 x Roll, Pitch and Heave Sensor (optional)

The data processing sub–system is made up of the following units :

- o Main computer
- o DDS tape drive
- o Disk drive
- o Graphics monitor
- o A0 Color plotter
- o A1 Color plotter
- o A3/A4 Color printer

1.2.3 Technical Data

Acoustic system

o Operating Voltage	: 230 V AC / 115 V AC, Plug coded
o On/Off switching	: man. or remote via host computer
o Power consumption	: approx. 200 W, Softstart
o System monitoring	: Temperature monitoring in power amplifier and preamplifier, shutdown at 70° C Automatic Power Fail reset
o Frequency	: 50 / 180 kHz
o Max. pulse power	: 3000 W per transducer @ 50 kHz : 600 W per transducer @ 180 kHz
o Max. source level	: 234 db/mPascal/m@ 50 kHz : 220 db/mPascal/m@ 180 kHz
o Pulse length	: 0.3, 1, 3 or 10 msec @ 50 kHz 0.15, 0.3, 1 or 3 msec @ 180 kHz
o Side lobe suppression (Transmission x Reception)	:>30 db @ 50 kHz, >36 db @ 180 kHz
o Beamwidth	: 3° x 4.8°@ 50 kHz 3.5° x 6°@ 180 kHz
o Number of beams	: 56 (fewer selectable)
o Thwartship sector	: ± 60°
o Maximum ship's speed for continuous sea bed coverage	: approx. 10 Knot
o Transducer arrays (V−configuration)	: 2 x LSE 237@ 50 kHz, : 2 x LSE 296@ 180 kHz
o Transducer size	: LSE 237 : 530 x 290 mm each : LSE 296 : 255 x 180 mm each
o Environmental Cond.	: Operating : 0° C to +40° C Store : −20° C to + 70° C
o Weight	: approx. 50 kg without case
o Dimensions	: 480 x 560 x 360 mm

Heave/roll/pitch sensor

- o TSS 335 or TSS 1

Sub–assemblies contained within the SEE 28 are :

- o 4 x Transmitter Beamformer Power Stage : PGN 45
- o 4 x Transmit/Receive Decoupler Unit : EBE 159
- o 2 x AGC/TVG Preamplifier–Prefilter : LV 198
- o 1 x Postfilter : LV 199
- o 1 x Receive Beamformer : PSE 16
- o 1 x Beamformer Controller : PSE 17
- o 1 x System Controller : EBE 156
- o 1 x Systemstatus Display : DAE 31
- o 2 x CPU : PSE 12
- o 1 x Serial Interface PC Test : EBE 154
- o 1 x Main Power Controller : EBE 155
- o 1 x Main Power Supply : NG 1
- o 1 x Main Power Supply : NG 2
- o 1 x Ventilation Unit

LAMPIRAN D

Contoh Peta Dasar Laut Hasil Pemeruman Multibeam Echosounder 2 dimensi dan 3 dimensi

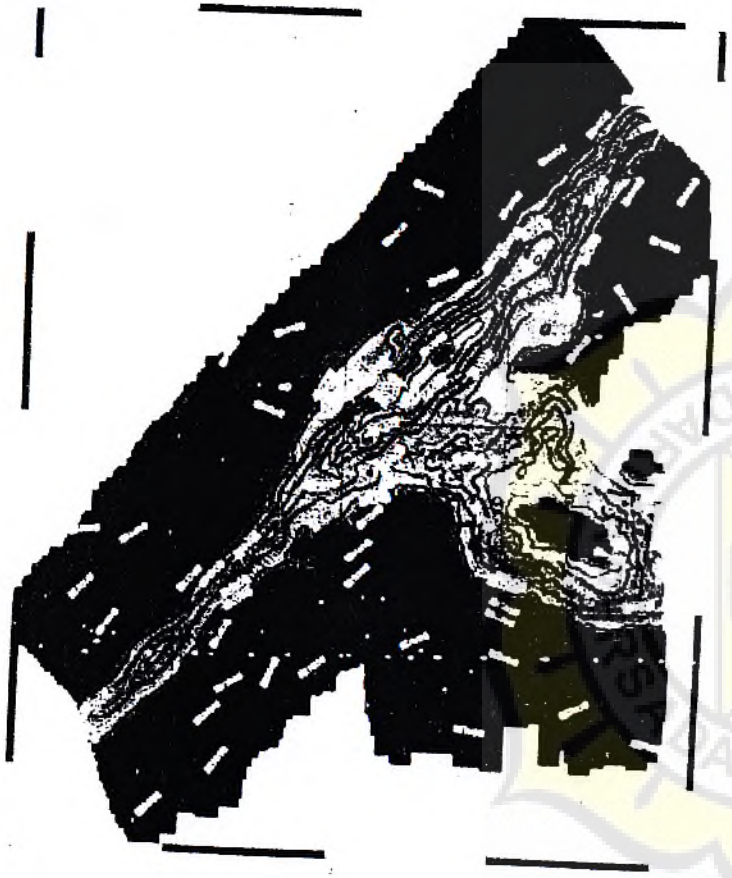


Figure 24 - 2D Bathymetry

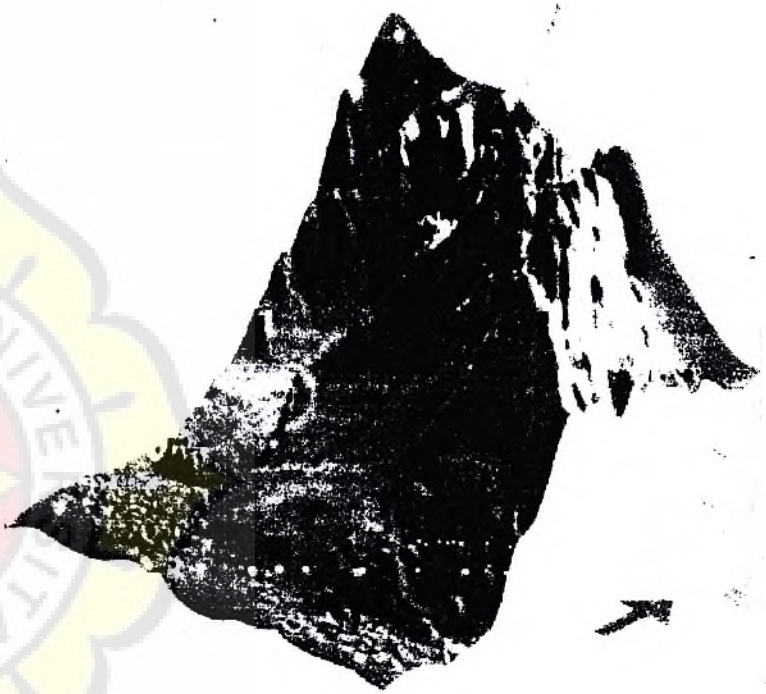
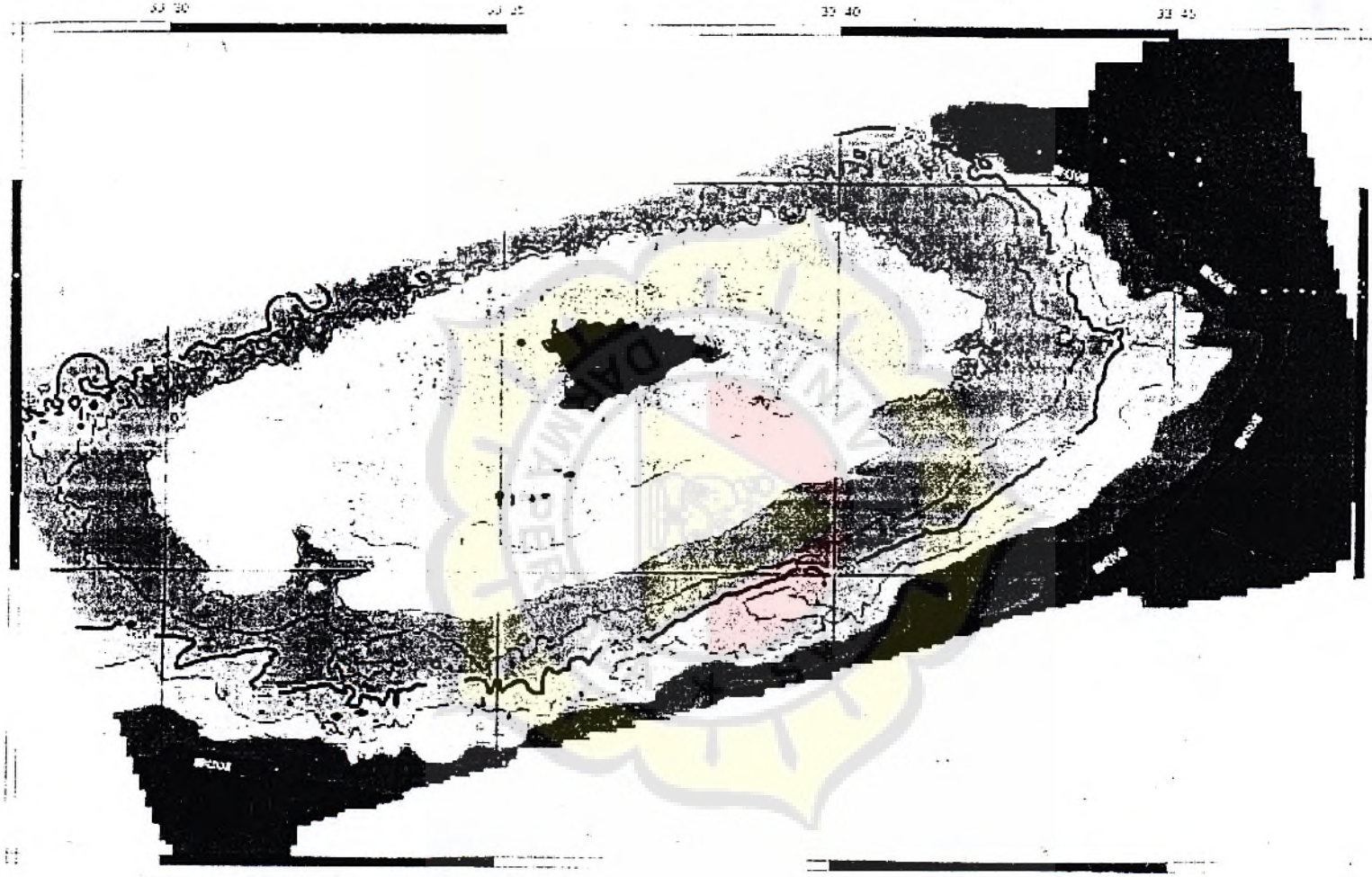
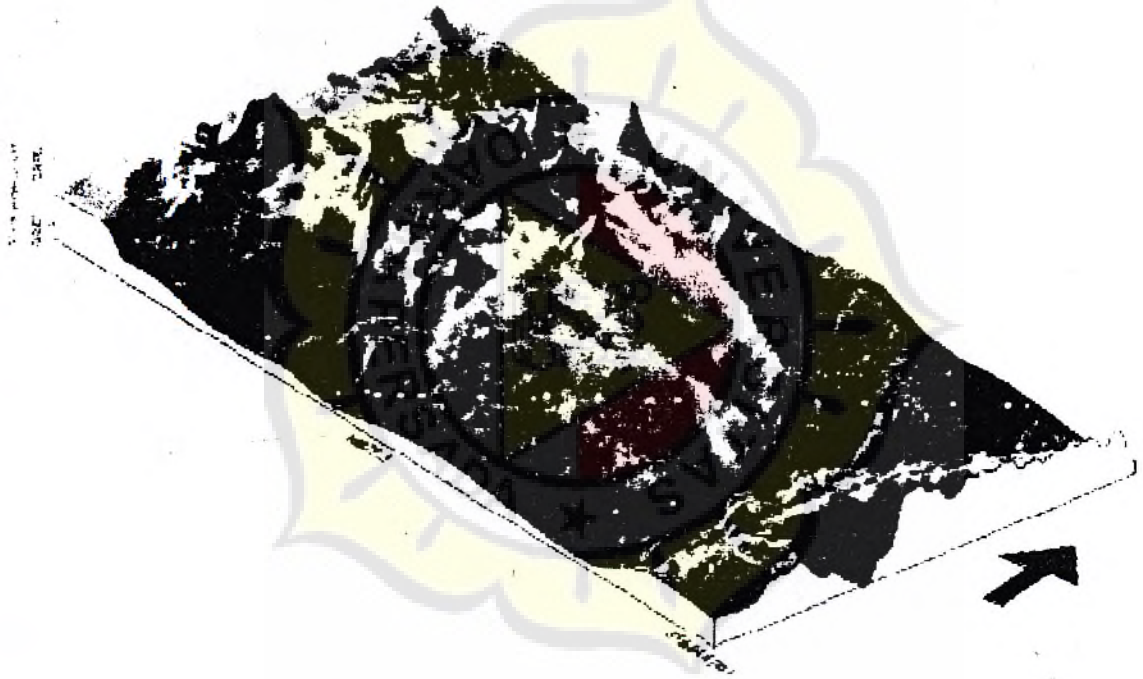


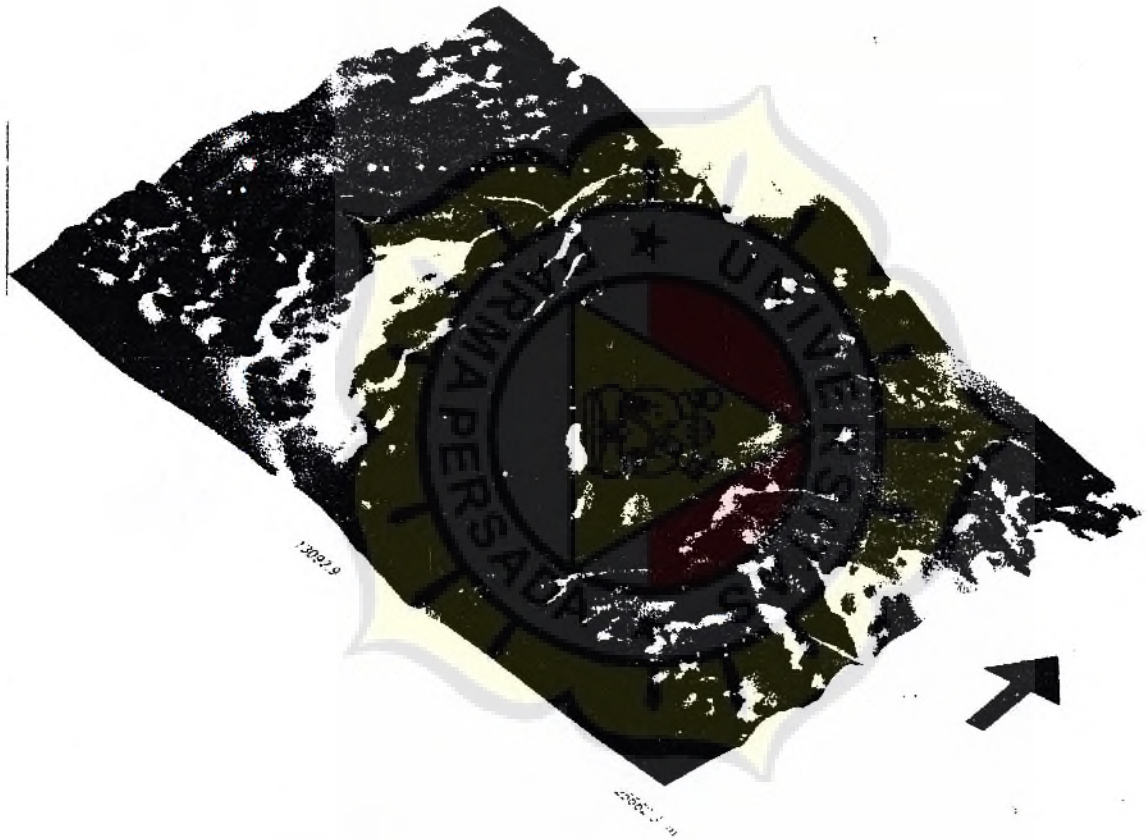
Figure 25 - 3D Bathymetry





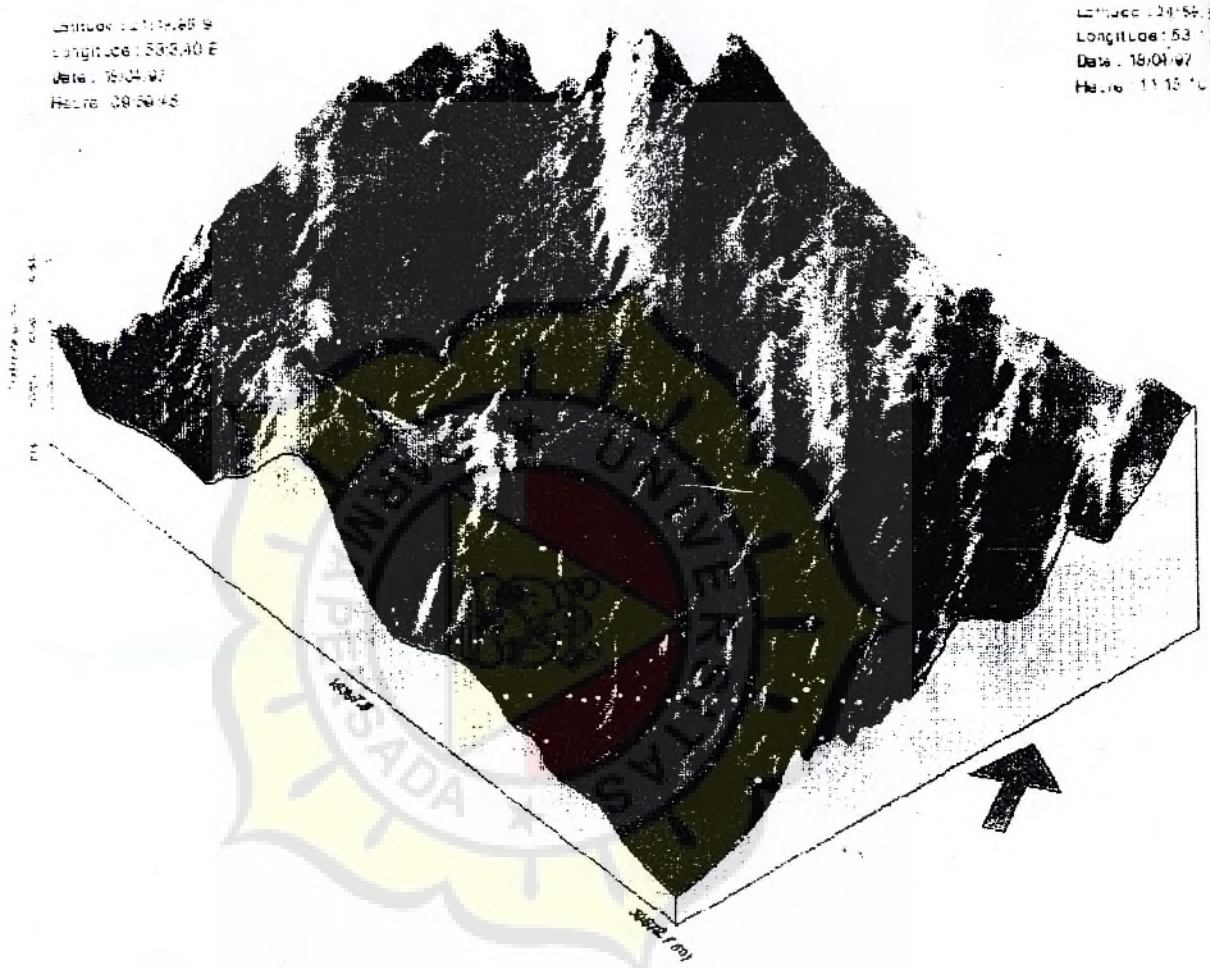
Latitude 46:28 44 S
Longitude 99:26.09 E
Date : 29 04 97
Heure 12.15:00

Latitude : 46.31.26 S
Longitude : 99 45 40 E
Date : 29 04 97
Heure : 13:15.11



Latitude : 39.54 40 S
Longitude : 78°9 19 E
Date : 22/04/97
Heure : 23:29:53

Latitude : 40 7 57 S
Longitude : 78.15 42 E
Date : 23/04/97
Heure : 00:30:04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Date : 16/04/97
Heure : 08:59:45
Longitude : 53 ' / 9 1 E
Date : 18/04/97

UNIVERSITAS DARMA PERSADA
FAKULTAS TEKNOLOGI KELAUTAN
JURUSAN TEKNIK PERKAPALAN
Jl. Radin Inten II, Pondok Kelapa Jakarta Timur, 13450
Telp . 8649051-57 Pes. 2029,2026

LEMBAR ASISTENSI
TUGAS AKHIR / SKRIPSI

Nama : **PRISETIO WISNU DARMAWAN**

N.I.M : 97310903

Judul : **APLIKASI MULTIBEAM ECHOSOUNDER PADA KAPAL RISET TIPE BARUNA JAYA**

No.	Tanggal	Materi	Paraf
1.	12/6-00	Daftar isi dan relevansi pembahasan	
2.	27/7-00	- Sumber2 pembahasan - 4.1. Pemanfaatan. - 4.2. Penempatan unit yg. - Ingat: tipe Baruna J. - Analisa bukan kesimpulan. - Analisa berdasarkan teori2 yg disampaikan. - Kesimpulan diambil menurut pengamatan sdr dari analisa. - 4.4.4. Perjelas analisa baru apa yg jadi parameter disampaikan.	
3.	31/7-00	- Sb. unit operator - Hal2, Kesimpulan (*). SIAP UJIAN	

Mengetahui
Pembimbing I

Ir Marthin J. Tamaela

UNIVERSITAS DARMA PERSADA
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Jl. Radin Inten II, Pondok Kelapa Jakarta Timur, 13450
Telp . 8649051-57 Pes. 2029,2026

LEMBAR ASISTENSI
TUGAS AKHIR / SKRIPSI

Nama : **PRISETIO WISNU DARMAWAN**

N.I.M : 97310903

Judul : **APLIKASI MULTIBEAM ECHOSOUNDER PADA KAPAL RISET TIPE BARUNA JAYA**

No.	Tanggal	Materi	Paraf
1.	2 juni 2000	Perbaikan Bab I	
2.	20 juni 2000	Lanjutkan ke Bab II	
3.	28 juni "	- Hal. 4. Bab II. angka. 34,765 ?	
4.	30 juni "	- Lanjutkan ke Bab III - rumus disertai referensi & lampiran. - referensi rumus dicopykan	

Mengetahui
Pembimbing II

Ir. [illegible] . M.