PROJECT DOCUMENTATION REPORT
SOUTHERN CALIFORNIA AEW RANGE (SOAR) SURVEY
AUGUST 1985
FPO-1-85 (28)

Ocean Engineering
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON NAVY YARD
WASHINGTON, DC 20374

Distribution Statement A
Approved for public release
Distribution Unlimited
PROJECT DOCUMENTATION REPORT
SOUTHERN CALIFORNIA ASW RANGE
(SOAR) SURVEY
AUGUST 1985
FPO-1-85 (28)

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Approved:

CDR A. M. PARISI, CEC, USN
Head Ocean Engineering &
Construction Project Office

DISTRIBUTION STATEMENT A
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The Southern California ASW Range (SOAR) Phase 1B will provide a 100 square mile Anti-Submarine Warfare Training Range in 4,500 feet of seawater west of San Clemente Island, California. An underwater survey of the near shore area of SOAR was to provide geotechnical & environmental data for the shore (Con't).
Landing of underwater cables to be installed in 1987 (SOAR Phase 1B). The survey was conducted in two parts: (a) A diver conducted cable inspection of two existing cables and geotechnical data gathering in the near shore area, (b) A hydrographic survey including bathymetry, sub-bottom profile, side scan sonar and current meter data. Both portions of the survey confirmed the presence of two sand covered channels adjacent to West Cove Beach, the proposed cable landing site. They offer potentially good shore landing cable routes to the eastern portion of the survey area where sand thicknesses exceed 60 feet. The western part of the survey area in about 200-300 FSW where sand thicknesses are relatively thin should be avoided although dynamic wave-induced motion of the cable should not be a problem at this depth. The survey provided a good image of the bottom and sub-bottom physical characteristics of the area permitting the development of a cable route to deepwater that provides maximum cable protection. The results of the survey also provide data necessary for cable design and nearshore protection requirements.
EXECUTIVE SUMMARY

The Southern California ASW Range (SOAR) Phase 1B will provide a 100 square mile Anti-Submarine Warfare Training Range in 4,500 feet of seawater west of San Clemente Island, California. An underwater survey of the near shore area of SOAR was conducted in April and May of 1985. The survey was to provide geotechnical and environmental data for the shore landing of underwater cables to be installed in 1987 (SOAR Phase 1B). The survey was conducted in two parts: (a) A diver conducted cable inspection of two existing cables and geotechnical data gathering in the near shore area. (b) A hydrographic survey including bathymetry, sub-bottom profile, side scan sonar and current meter data. Both portions of the survey confirmed the presence of two sand covered channels adjacent to West Cove Beach, the proposed cable landing site. They offer potentially good shore landing cable routes to the eastern portion of the survey area where sand thicknesses exceed 60 feet. The western part of the survey area in about 200-300 FSW where sand thicknesses are relatively thin should be avoided although dynamic wave-induced motion of the cable should not be a problem at this depth. The survey provided a good image of the bottom and sub-bottom physical characteristics of the area permitting the development of a cable route to deepwater that provides maximum cable protection. The results of the survey also provide data necessary for cable design and nearshore protection requirements.
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<td>16</td>
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</table>
1.0 MANAGEMENT SUMMARY

1.1 Introduction

The Southern California ASW Range (SOAR) Phase 1B will provide a 100 square mile Anti-Submarine Warfare training range in 4,500 feet of sea water west of San Clemente Island, California. SOAR will provide accurate tracking of air, surface and submerged targets.

The in-water portion of SOAR (Phase 1A) was installed by the Chesapeake Division, Naval Facilities Engineering Command (CHESNAVFACENGCOM) in September 1984. The cabled system of the range is comprised of two systems: An underwater communications link (WQC); and a sub-surface link (SSL) for data transmission with range transponder units. Each is linked to shore by an underwater cable terminated at West Cove, San Clemente Island, CA.

This Project Documentation Report presents the results of an underwater survey of the near shore area of SOAR conducted in April and May of 1985. The purpose of the survey was to provide geotechnical and environmental data for the shore landing of underwater cables to be installed in 1987 SOAR (Phase 1B). The results of the survey will provide: (a) A basis for environmental factors required for cable design; (b) Geophysical data for cable location; (c) Data necessary for the Naval Ocean System Center (NOSC) to support an environmental impact statement, and (d) Provide to the Naval Underwater System Center (NUSC) the near shore portion of the total (SOAR) range survey (the offshore survey will be completed by NUSC).

The near shore survey was conducted in two parts, as follows:
(a) A diver conducted cable inspection of two existing cables and geotechnical data gathering in the near shore area.
(b) A hydrographic survey of bathymetry, sub-bottom profile, side scan sonar and current meter data.

NUSC, in conjunction with Naval Oceanographic Office (NAVOCEANO) will conduct a survey of the offshore SOAR area. The survey described herein will complement the offshore survey by providing data necessary primarily for cable design, near shore protection requirements and installation. (Refer to Figure 1.)

This Project Documentation Report presents the findings of the two part near shore underwater survey. The Project Execution Plan, Chesapeake Division document number FPO-1-85(28), is referenced as the detailed execution plan.
1.2 Program Management

The Chief of Naval Operations tasked NAVAIR to form a team for the planning and execution of SOAR. The overall program manager for the SOAR Project is the Director, Range Instrumentation Division (AIR-630) of the Naval Air Systems Command. AIR-630 is the Head of the Sea Range Projects Branch. Within this branch, the Underwater Systems Engineer (AIR-6303F) is responsible for the management and execution of the Project. NUSC has been assigned as the Technical Direction Agent (TDA) for the project who in turn tasked the Chesapeake Division of Naval Facilities Engineering Command (CHESNAVFACENGCOM), Ocean Engineering and Construction Project Office, Code FPO-1, with the near shore survey portion of the project.

NUSC, as TDA, provided technical direction for the surveys. The in-water portion was managed by CHESNAVFACENGCOM, Code FPO-1. Code FPO-1 was supported by Underwater Construction Team Two (UCT-2), and NOSC, San Diego, as shown in Figure 2.

1.3 Construction Operations Summary

Below is a chronological record of events during the SOAR cable survey.

<table>
<thead>
<tr>
<th>DATE PLANNED</th>
<th>DATE ACTUAL</th>
<th>EVENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 22</td>
<td>April 21</td>
<td>Mobilization of TRB at NOSC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Installation of SAIC Integrated Navigation &amp; Data Acquisition Systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*TRB had engine trouble used NOSC IX506</td>
</tr>
<tr>
<td>April 23</td>
<td>April 22</td>
<td>Air transport of survey team to SCI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IX506 transit to SCI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Barge transport of UCT-2 equipment</td>
</tr>
<tr>
<td>April 24</td>
<td>April 23</td>
<td>Start SAIC hydrographic survey</td>
</tr>
<tr>
<td></td>
<td>April 24</td>
<td>Current meters installed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*IX506 directed return San Diego due to weather</td>
</tr>
<tr>
<td></td>
<td>April 25</td>
<td>IX506 out of commission due to engine room power box fire</td>
</tr>
</tbody>
</table>
Figure 2
Program Management
April 26  *NUSC contract EGABRAG III via DOE.
   EGABRAG III in transit to SCI.
April 24  April 27  -EGABRAG III begin survey
April 29  April 29  -UCT-2 personnel transit to SCI
April 30  April 30  -Start Diver Survey
May  1   April 29  -Complete hydrographic survey
May  2   April 29  -Demobilization of Egabraq III
May  9   May  9   -Complete Diver Survey
May 13  May 11  -Transportation of UCT-2 personnel
to San Diego
May 15  May 14  -Barge transit of UCT-2 equipment
to San Diego

*Denotes unplanned events

2.0 LOCATION DETAILS

2.1 Construction Site

San Clemente Island is used by the Navy as an ordnance
delivery test and evaluation site. Transportation to the
island, 70 miles west of San Diego, is by daily aircraft flight
or by barge once each week. All food, fuels, water, and other
supplies are transported to the island.

The West Cove cable landing site consists of rock covered
by loose sand. The beach extends seaward at a shallow slope.
The near shore underwater area is sand with several
outcroppings of rock.

2.2 Geographical Data

The reference stations utilized in both the hydrographic
and near shore diver survey were located on control points with
coordinates shown below. The hydrographic survey used the Del
Norte navigation system with shore stations set on Captaine 3
and Lamar 1. The near shore diver survey utilized transits set
on Captaine 3 and Pad 1 and angles turned clockwise from true
north. A location map is shown in Figure 3 representing
relative distances between control points.
Figure 3
Navigation Shore Stations
LAMBERT GEODETIC

"LAMAR 1"  
N 316,921.69  
E 1,278,554.83

"CAPTAINE 3"  
N 317,612.03  
E 1,282,827.48

"PAD 1"  
N 316,847.76  
E 1,279,178.97

2.3 Weather

A single foul weather day occurred during this project where operations had to be scrubbed as the IX506 was directed to return to San Diego. The on site engineer reported 6-8' swells and 20-25 kt winds, and building. Primarily, the weather was calm with 8-12 knot winds and 3-5 ft. swells being reported.

3.0 SURVEY DETAILS

3.1 Diver Cable Inspection and Survey

The two existing WQC & SSL cables were inspected by Underwater Construction Team-Two (UCT-2) as they proceeded along the cable. Marker Buoys were attached to numbered reference tags on the cable and these buoys "shot-in" from shore with transits to verify "as-built" conditions. Survey data with transit angles from control points and diver remarks can be found in Appendix A. The apparent displacement of the cable from the "as-built" conditions could be due to inaccuracies of survey techniques. The condition of the cable is very good with most of the cable buried in sand 4"-6" to 100 FSW, the extent of the diver inspection. The WQC cable does have one suspension that is 100' between suspension points and has a sag of about 8"-12". The suspension will be removed or reduced during the next survey period in the summer of 1986. Underwater video taping from 10 FSW to 90 FSW was performed on each of the cables to document their condition. Original video tapes are in possession of CHESNAVFACENGCOM.

Rock outcroppings were located using the jet probe. A large sand covered channel about 20'-40' in width was found between two rock outcroppings. Sand overlaying rock in this channel is at least 9 feet thick as found by the divers. The sand covered channel could be used as a cable laying lane for future cable lays. The surveyed rock locations and sand depths verified the conditions found during the SAIC geophysical survey.
Four sand sample cores were taken from San Clemente by the divers using the Naval Civil Engineering Laboratory (NCEL) geotechnical diver tools. The locations of these sand samples are shown in Figure 4. After being brought to the beach each sand sample was carefully sealed and prepared for shipment. The samples were delivered to NCEL where an analysis was performed. Detailed results of the laboratory testing of the soil samples are presented in Appendix B, showing general soil data and grain size distribution. The soil is a coarse to medium calcareous sand with densities ranging from 111.6 to 121.3 pcf. Specific gravities ranged from 2.72 to 2.74. The friction angle for all four samples was 37°. All the cores contained shell fragments, the amounts increasing with depth.

The most significant and useful data is the friction angle. This data will be used to determine the holding capacity of propellant embedment anchors being considered for anchoring the junction box.

Rock samples were also secured from the West Cove area and analyzed at NCEL. The results are shown in Appendix B. The rocks were visually identified as volcanic, probably porphyritic felsites. The compressive strengths ranges from 4,500 psi to 8,200 psi, with one test specimen reaching 10,320 psi.

3.2 Hydrographic Survey

To obtain the necessary data for specifying cable design and optimum cable routes, Science Applications International Corporation (SAIC) was tasked to conduct a detailed geophysical survey of an area approximately one nautical mile wide extending from the shore to three nautical miles seaward, (Figure 1) where depth exceeds 600 feet.

Figure 5 shows the ship's track coverage of the survey area. Line spacings varies from about 50m in the Northern part of the survey area to about 100 meters over the southern self and slope areas.

The geophysical survey consisted of side-scan, sub-bottom profiling and bathymetry over the entire study area. In addition, two bottom mounted current meters were installed in about 30 and 65 feet of water off of West Cove in order to obtain data on the dynamic wave-induced current velocity field. Both current meters measure direction and wave pressure fluctuations, the deep meter also measures temperature. Figure 4 shows the locations of the deep and shallow current meter emplacements. Data from the two current meters can be reviewed in Appendix C. Figure 6 shows a typical Side Scan record with a clearly defined sand lens over bedrock.
Figure 3  Ship's Track Coverage of Survey Area
Figure 6: Example of a subbottom record showing a sand lens between the seafloor and the isopach.
Each data set has been analyzed according to procedures outlined in Appendix C. The final product consists of a side scan sonar mosaic which forms a base chart for overlaying the bathymetry and isopach charts, reproduced on semi-transparent mylar. The bathymetry and isopach data can be readily assessed in relation to the side scan acoustic image of the bottom. The presence of rock outcroppings in relation to depth and sediment thickness is immediately apparent and provides an efficient method for detailed planning for the in-shore portions of the SOAR cable installation project. The original mosaic was separated into ten plates and each plate was photographically reduced to a scale of 1:2400. Figure 7 shows the distribution of the 1:2400 scale plates in relation to the 1:8400 chart. Figure 8a, b, and c are the 1:8400 charts reduced to 60% for this report and reproduced in black and white on paper. All original color mylar overlays and Side Scan mosaics are available at CHESNAVFACENGCOM. Commander, Anti Submarine Warfare Wing-Pacific and Naval Underwater Systems Center (NUSC) were provided with copies of all overlays and mosaics.

4.0 CONCLUSIONS

Intergrating the data from UCT-2 underwater survey and SAIC bathymetric survey provides a clear view of the sea bottom at West Cove and seaward. The side scan mosaic of the survey area shows a sand covered bottom with rock outcroppings fringing West Cove to the north and west. The sub-bottom survey indicated a channel in the rock 20 to 40 feet in width with sand thicknesses of 10 to 18 feet extending into West Cove to about 40 FSW, the inshore limit of the towed array. The diver survey confirmed this channel running to shore with sand thicknesses of at least 9 feet. This sand channel may be a viable lane to use as a cable route to the east-central portion of the survey area where sand coverage is as thick as 80'.

In the central part of the survey area several rock outcroppings are evident and should be avoided during the next cable lay. The western portion of the survey area, where surface or nearsurface rock outcroppings are present, in about 200-300 FSW, should be avoided although dynamic wave-induced motion of the cable should not be a problem. The current meters scheduled to be recovered in October should be left in place during the winter months to provide information on wave induced currents during the most severe weather windows.
<table>
<thead>
<tr>
<th>H</th>
<th>V</th>
<th>H</th>
<th>V</th>
<th>REMARKS</th>
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<tr>
<td>95° 28' 30&quot;</td>
<td>1° 31&quot;</td>
<td>245° 59' 40&quot;</td>
<td>3° 30&quot;</td>
<td>T4 BURIED 2-4&quot;</td>
</tr>
<tr>
<td>100° 58' 30&quot;</td>
<td>1° 31&quot;</td>
<td>243° 56' 20&quot;</td>
<td>3° 20&quot;</td>
<td>T6 BURIED 4-6&quot;</td>
</tr>
<tr>
<td>106° 21' 30&quot;</td>
<td>1° 30&quot;</td>
<td>240° 32' 20&quot;</td>
<td>3° 13&quot;</td>
<td>T8</td>
</tr>
<tr>
<td>115° 44' 00&quot;</td>
<td>1° 30&quot;</td>
<td>237° 08' 00&quot;</td>
<td>3° 0&quot;</td>
<td>T10 LAST SPLIT PIPE</td>
</tr>
<tr>
<td>123° 09' 00&quot;</td>
<td>1° 30&quot;</td>
<td>235° 32' 20&quot;</td>
<td>2° 36&quot;</td>
<td>T12 2&quot; SAND</td>
</tr>
<tr>
<td>130° 38' 30&quot;</td>
<td>1° 30&quot;</td>
<td>233° 05' 40&quot;</td>
<td>2° 31&quot;</td>
<td>T14 2-4&quot; SAND</td>
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<td>137° 15' 20&quot;</td>
<td>1° 30&quot;</td>
<td>231° 52' 20&quot;</td>
<td>2° 20&quot;</td>
<td>T16 ANCHOR AN CABLE</td>
</tr>
<tr>
<td>143° 43' 00&quot;</td>
<td>1° 30&quot;</td>
<td>231° 31' 40&quot;</td>
<td>2° 15&quot;</td>
<td>T18 60 FSW 4-6&quot; SAND</td>
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<td>148° 20' 06&quot;</td>
<td>1° 30&quot;</td>
<td>229° 30' 10&quot;</td>
<td>2° 13&quot;</td>
<td>T20</td>
</tr>
<tr>
<td>155° 00' 00&quot;</td>
<td>1° 30&quot;</td>
<td>229° 30' 10&quot;</td>
<td>2° 13&quot;</td>
<td>T23</td>
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<tr>
<td>90° 45' 20&quot;</td>
<td>1° 40&quot;</td>
<td>249° 48' 40&quot;</td>
<td></td>
<td>T3 UNDER SAND TO</td>
</tr>
<tr>
<td>97° 07' 20&quot;</td>
<td>1° 36&quot;</td>
<td>246° 00' 20&quot;</td>
<td></td>
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<td>105° 20' 00&quot;</td>
<td>1° 30&quot;</td>
<td>243° 00' 10&quot;</td>
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<td>T7 37 FSW SPLIT PIPE</td>
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<td>113° 15' 20&quot;</td>
<td>1° 30&quot;</td>
<td>240° 33' 40&quot;</td>
<td>3° 0&quot;</td>
<td>T9 50 FSW</td>
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<td>121° 17' 20&quot;</td>
<td>1° 30&quot;</td>
<td>238° 51' 20&quot;</td>
<td>3° 0&quot;</td>
<td>T11</td>
</tr>
<tr>
<td>129° 09' 00&quot;</td>
<td>1° 30&quot;</td>
<td>237° 14' 20&quot;</td>
<td>3° 0&quot;</td>
<td>T15</td>
</tr>
<tr>
<td>145° 10' 20&quot;</td>
<td>1° 30&quot;</td>
<td>236° 09' 00&quot;</td>
<td>3° 0&quot;</td>
<td>T17</td>
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<tr>
<td>153° 12' 20&quot;</td>
<td>1° 30&quot;</td>
<td>234° 54' 20&quot;</td>
<td>2° 40&quot;</td>
<td>T19 SUSPENSION 100'</td>
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<td>160° 09' 20&quot;</td>
<td>1° 30&quot;</td>
<td>233° 56' 20&quot;</td>
<td>2° 40&quot;</td>
<td>T21 LONG 8-12&quot; SAG</td>
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<td>165° 57' 10&quot;</td>
<td>1° 30&quot;</td>
<td>232° 15' 20&quot;</td>
<td>2° 40&quot;</td>
<td>T23 90 FSW</td>
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<td>DEPTH/BOUY</td>
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<td>V2</td>
<td>REMARKS</td>
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<td>------------</td>
<td>----</td>
<td>----</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td>30/3</td>
<td>216° 29' 20&quot;</td>
<td>125° 43'</td>
<td>Rock-commercial yellow float</td>
<td></td>
</tr>
<tr>
<td>30/4</td>
<td>224° 40'</td>
<td>127° 07'</td>
<td>All sand</td>
<td></td>
</tr>
<tr>
<td>30/5</td>
<td>231° 45'</td>
<td>127° 31'</td>
<td>Sand all around this mark</td>
<td></td>
</tr>
<tr>
<td>30/6</td>
<td>238° 10'</td>
<td>128° 01'</td>
<td>Sand-more sand to east-pt. near SSL</td>
<td></td>
</tr>
<tr>
<td>60/1</td>
<td>221° 50' 20&quot;</td>
<td>143° 40'</td>
<td>Rock surroundings 50' of this position</td>
<td></td>
</tr>
<tr>
<td>60/3</td>
<td>228°</td>
<td>144°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60/4</td>
<td>229° 44' 10&quot;</td>
<td>144° 30'</td>
<td>Sand-20' east starts rock</td>
<td></td>
</tr>
<tr>
<td>60/5</td>
<td>230° 20'</td>
<td>148° 01'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60/6</td>
<td>231° 41' 20&quot;</td>
<td>144° 46'</td>
<td>4&quot;-6&quot; sand over rock</td>
<td></td>
</tr>
<tr>
<td>60/SSL</td>
<td></td>
<td></td>
<td>2&quot;-3&quot; sand over rock</td>
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</tr>
<tr>
<td>60/WQC</td>
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<tr>
<td>70/1</td>
<td>216° 57' 20&quot;</td>
<td>139° 56'</td>
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<td></td>
</tr>
<tr>
<td>70/2</td>
<td>231° 25' 20&quot;</td>
<td>136° 07'</td>
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</tr>
<tr>
<td>90/1</td>
<td>224° 10'</td>
<td>163° 08'</td>
<td>Sand</td>
<td></td>
</tr>
<tr>
<td>90/2</td>
<td>228° 0'</td>
<td>165° 57'</td>
<td>Sand</td>
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</tr>
<tr>
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<td>223° 26' 40&quot;</td>
<td>166° 26'</td>
<td>Sand</td>
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</tr>
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<td>90/4</td>
<td></td>
<td></td>
<td>On cable-buoy moved</td>
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<td>100/1</td>
<td>224° 25' 0&quot;</td>
<td>168° 13' 0&quot;</td>
<td>Sand</td>
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</tr>
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<td>228° 2' 40&quot;</td>
<td>170° 29' 0&quot;</td>
<td>Sand</td>
<td></td>
</tr>
<tr>
<td>100/3</td>
<td>230° 0' 40&quot;</td>
<td>173° 14'</td>
<td>Sand</td>
<td></td>
</tr>
<tr>
<td>100/4</td>
<td>233° 28' 40&quot;</td>
<td>177° 58'</td>
<td>20' west of SSL</td>
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**DESIGN CAPTAIN 3**

**PAD 1**

### ROCK EDGE SURVEY

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<th>Longitude</th>
<th>Remarks</th>
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<td>A</td>
<td>231° 40'</td>
<td>156° 47'</td>
<td>80FSW near SSL</td>
</tr>
<tr>
<td>B</td>
<td>228° 49' 20&quot;</td>
<td>159° 57'</td>
<td>90FSW near SSL</td>
</tr>
<tr>
<td>C</td>
<td>226° 45' 20&quot;</td>
<td></td>
<td>Point of rock-seaward limit 92FSW</td>
</tr>
<tr>
<td>D</td>
<td>224° 54' 0&quot;</td>
<td>159° 02'</td>
<td>Sand to east and south</td>
</tr>
</tbody>
</table>

### CORE SAMPLES

<table>
<thead>
<tr>
<th></th>
<th>Latitude</th>
<th>Longitude</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>1</td>
<td>227° 10'</td>
<td>173° 30'</td>
<td>105FSW</td>
</tr>
<tr>
<td>2</td>
<td>226° 30'</td>
<td>165° 0'</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>223° 0'</td>
<td>166° 06'</td>
<td>87FSW</td>
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<tr>
<td>4</td>
<td>223° 0'</td>
<td>160° 50'</td>
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### NEAR SHORE INSPECTION

<table>
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<tr>
<td>NS1</td>
<td>225° 25' 10&quot;</td>
<td>117° 15'</td>
<td>2-3' sand cover, 5' north is rock</td>
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<tr>
<td>NS2</td>
<td>221° 44' 20&quot;</td>
<td>122° 32'</td>
<td>3' sand cover, 8'north is rock</td>
</tr>
<tr>
<td>NS3</td>
<td>219° 53' 10&quot;</td>
<td>127° 0'</td>
<td>3' sand cover, 10' is rock</td>
</tr>
<tr>
<td>NS4</td>
<td>228° 20'</td>
<td>106° 56'</td>
<td>6&quot; sand</td>
</tr>
<tr>
<td>NS5</td>
<td>224° 38'</td>
<td>109° 11'</td>
<td>6&quot; sand, heavy keip</td>
</tr>
<tr>
<td>NS6</td>
<td>223° 10' 10&quot;</td>
<td>108° 43'</td>
<td>15' into rock</td>
</tr>
<tr>
<td>NS7</td>
<td>223° 30'</td>
<td>135° 37'</td>
<td>2' sand cover</td>
</tr>
<tr>
<td>NS8</td>
<td>239° 12'</td>
<td>161° 12'</td>
<td>sand-rock on surface 15' west</td>
</tr>
<tr>
<td>NS9</td>
<td>224° 13'</td>
<td>103° 20'</td>
<td>all rock to west side</td>
</tr>
<tr>
<td>NS10</td>
<td>245° 07'</td>
<td>101° 54'</td>
<td>all rock to west side</td>
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APPENDIX B

GEOTECHNICAL ANALYSIS
<table>
<thead>
<tr>
<th>Site/Drill</th>
<th>Core Length (inches)</th>
<th>Corer Penetration</th>
<th>Core Penetration</th>
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<tbody>
<tr>
<td>105SW</td>
<td>#1 21</td>
<td>Full</td>
<td>Hard</td>
</tr>
<tr>
<td>97FSW</td>
<td>#2 23</td>
<td>Full</td>
<td>Hard</td>
</tr>
<tr>
<td>#3</td>
<td>15</td>
<td>Full</td>
<td>Easy</td>
</tr>
<tr>
<td>200SW</td>
<td>#4 30</td>
<td>Full</td>
<td>Easy</td>
</tr>
</tbody>
</table>

Observations: Core should be collected slowly by hand, core sample should be extracted to core out 12 inch of below water, while hand can put in place to prevent sample from aggregating at bottom of tunnel.

Problems: Tub unanswered from head nut.
From: Commanding Officer, Naval Civil Engineering Laboratory, Port Hueneme
To: Commanding Officer, Chesapeake Division, Naval Facilities Engineering Command, Washington Navy Yard, Washington, D.C. 20374
(FPO-1/Keith Cooper)

Subj: GEOTECHNICAL ANALYSIS - WEST COVE, SAN CLEMENTE ISLAND, CALIFORNIA

Ref: (a) CHESNAVFACENGCOM Work Request N624778WR50729 of 2 Apr 85
(b) PHONCON CHESNAVFACENGCOM (FPO-1) Keith Cooper/NAV CIVENGRLAB (Code L42)

Norm Albertsen of 3 Jul 85

Encl: (1) Soil Data Summary Chart
(2) Grain Size Graphs
(3) Rock Sample Analysis Memorandum
(4) Rock Compressive Strength

1. By reference (a), the Naval Civil Engineering Laboratory (NAV CIVENGRLAB) was requested to provide support to FPO-1 for the site survey of West Cove, San Clemente Island, California. This support consisted of providing the Underwater Construction Team Two (UCT-2) with geotechnical diver tools and supplies and providing laboratory analysis of the samples taken. The diver tool kits (impact corer, MSPT and jet probe) were supplied to UCT-2 and the samples they brought back were analyzed. This letter is a summary report of the geotechnical analysis of those samples.

2. The samples brought to NAV CIVENGRLAB were four cores taken with the impact corer and five rocks that were approximately 12 inches long, 8 inches wide and 5 inches thick. The cores were analyzed in the Seafloor Soils Laboratory at NAV CIVENGRLAB. They were visually examined and subjected to a series of laboratory tests to determine general characteristics and engineering properties. Laboratory tests were performed to determine grain size, density, specific gravity, grain angularity, and friction angle. The rock samples were cored to provide specimens for compressive strength tests.

3. The results of the laboratory testing of the soil samples are shown in enclosure (1). The grain size charts are shown in enclosure (2). The soil is a coarse to medium calcareous sand with densities ranging from 111.6 to 121.3 pcf. The specific gravity ranged from 2.72 to 2.74. The friction angle for all four samples is 37°. All the cores contained shell fragments; the amount of fragments increased with depth in the core. The locations where the cores were taken was not available, therefore, no comment can be made on areal characteristics of the site.

4. The results of the rock sample tests are shown in enclosure (3). Cylindrical specimens were cut from the rocks and compression strength tests were performed on them following ASTM Standard D2938-79. There was some deviation from that standard. The specimens were 1-11/16 inches in diameter rather than 1-7/8 inches and 3-1/2 inches in length which satisfied the requirements of length equal to at least twice the diameter. The rock types were visually identified as volcanic, probably porphyrite felsites. The compressive strengths ranged from 4,500 psi to 8,200 psi, with one test specimen reaching 10,320 psi.
SUBJ: GEOTECHNICAL ANALYSIS - WEST COVE, SAN CLEMENTE ISLAND, CALIFORNIA

5. Questions concerning this information should be addressed to Barbara Johnson, Code L42, Naval Civil Engineering Laboratory, Port Hueneme, CA 93043, (805) 982-4362, A/V 360-4362, FTS 799-4362.

R. N. CORDY
By Direction
<table>
<thead>
<tr>
<th>Soil Data Summary Chart</th>
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<tbody>
<tr>
<td><strong>Sea Floor</strong></td>
</tr>
<tr>
<td><strong>0</strong></td>
</tr>
<tr>
<td><strong>5</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>10</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>15</strong></td>
</tr>
<tr>
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</tr>
<tr>
<td><strong>20</strong></td>
</tr>
<tr>
<td><strong>25</strong></td>
</tr>
<tr>
<td><strong>30</strong></td>
</tr>
</tbody>
</table>
MEMORANDUM
From: L42/Malloy
To: L42/Files
Subj: ROCK SAMPLES FROM SAN CLEMENTE ISLAND (WEST COVE); IDENTIFICATION OF

1. Five small boulders were collected at West Cove by UCT-2 divers and brought to NCEL for compressive tests and megascopic identification. All five rocks are similar lithologically, and appear to be porphyritic felsites, possibly rhyolite or quartz porphyries. All five samples show alternating dark and light grey banding, presumably flow (?) lines. All samples have rounded, subrounded, or angular fragments, ranging in size from a few millimeters to 5 centimeters. The most common inclusion is yellow, fine grained, soft, and hydroscopic; presumably pumice. All samples exhibited glassy phenocrysts with no plagioclase twinning, suggesting quartz. All samples are highly competent, hammer ringing rocks.

2. Individual differences in the five samples include:

Sample 1: This is the freshest looking rock. Dark and light grey flow (?) lines are parallel to the long axes of the cores taken for compressive tests.

Sample 2: This sample is tinted rust red in streaks throughout the sample. Flow (?) lines are approximately perpendicular to the cores' long axes.

Sample 3: This sample has coloration similar to Sample 1, but the flow (?) lines cut across the cores' long axes at about 30°.

Sample 4: This sample resembles number 2.

Sample 5: Flow (?) lines are less conspicuous in this sample. They appear to be parallel to the cores' long axes. Yellow to rusty porphyritic inclusions make up 30% of the sample.

3. In summary, the rock samples appear to be volcanic extrusives that picked up other volcanic rock debris in the process of flowing and may have included its own cooled fragments (flow breccia). This is a hand specimen identification. Thin section examination by petrographic microscope is recommended if a more precise identification is required.

R.J. Malloy

ENCLOSURE (1)
ROCK COMPRESSION STRENGTH

RESULTS OF AXIAL COMPRESSION TESTING OF SPECIMENS TAKEN FROM FIVE ROCK SAMPLES FROM SAN CLEMENTE ISLAND

<table>
<thead>
<tr>
<th>ROCK SAMPLES</th>
<th>CYLINDRICAL TEST SPECIMEN</th>
<th>AVERAGE COMPRESSIVE STRENGTH (PSI)</th>
</tr>
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<tbody>
<tr>
<td>SAMPLE 1</td>
<td>Specimen A&lt;sup&gt;1&lt;/sup&gt;</td>
<td>10,320 psi</td>
</tr>
<tr>
<td></td>
<td>Specimen B, C&lt;sup&gt;2&lt;/sup&gt;</td>
<td>5400 psi</td>
</tr>
<tr>
<td>SAMPLE 2</td>
<td>Specimen A, B, C&lt;sup&gt;2&lt;/sup&gt;</td>
<td>5700 psi</td>
</tr>
<tr>
<td>SAMPLE 3</td>
<td>Specimen A, B, C&lt;sup&gt;2&lt;/sup&gt;</td>
<td>4500 psi</td>
</tr>
<tr>
<td>SAMPLE 4</td>
<td>Specimen A, B&lt;sup&gt;2&lt;/sup&gt;</td>
<td>8200 psi</td>
</tr>
<tr>
<td>SAMPLE 5</td>
<td>Specimen A, B, C&lt;sup&gt;2&lt;/sup&gt;</td>
<td>6600 psi</td>
</tr>
</tbody>
</table>

1 Specimen A of rock sample 1 showed a compressive strength almost twice that of B and C, therefore, it was not included in the average value.

2 Specimens cut from rock sample showed similar compressive strengths and the values were averaged.
APPENDIX C

SAIC GEOPHYSICAL SURVEY
A GEOPHYSICAL SURVEY
OFF WEST COVE
SAN CLEMENTE ISLAND
for the
SOAR CABLE INSTALLATION PROJECT

July 29, 1985

Submitted to:
CHESNAVFACEENGCOM.
CODE FPO-1
Washington Navy Yard
Washington, D.C. 20374-2121

Submitted by:
Science Applications International Corporation
Admiral's Gate
221 Third Street
Newport, RI 02840
(401) 847-4210
Mr. Gerald Cook
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<td>8</td>
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<td>Example of Steeply Sloping Bedforms</td>
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<td>West Cove Survey Area</td>
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<td>U, V Velocity Components at Current Meter Sites</td>
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<td>Maximum Speed Per Burst Interval and Kinetic Energy</td>
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1.0 INTRODUCTION

The Chesapeake Division, Naval Facilities Engineering Command (CHESDIV) is tasked with the responsibility for the installation of underwater cables for the Southern California Acoustic Range (SOAR) located about 15 NM NW of San Clemente Island (SCI), CA (Fig. 1-1). Current plans require the laying of 22 hydrophone cables from the range area in deep water to a junction point in shallow water off West Cove, SCI. A single larger cable will be laid from the junction box shoreward through the surf zone to the Cable Termination Van (CTV).

The West Cove of SCI is fully exposed to the entire range of weather and oceanographic conditions that can occur. Since weather patterns in the SCI area generally move in an easterly direction, there are no fetch limitations to afford even a reasonable degree of protection for the West Cove area. Consequently, bottom conditions in relation to cable protection designs must be thoroughly assessed in order to insure a reasonable lifetime for the cables and result in longevity of the SOAR.

In order to obtain the necessary data for specifying cable design and optimum cable routes, Science Applications International Corporation (SAIC) was tasked to conduct a detailed geophysical survey of an area approximately one nautical mile wide and extending from the shore three nautical miles seaward (Fig. 1-1) where depths exceed 600 feet.

The geophysical survey consisted of side scan, subbottom profiling and bathymetry over the entire study area. In addition, two bottom mounted current meters were installed in about 30 and 65 feet of water off West Cove in order to obtain data on the dynamic wave-induced current velocity field in relation to the potential sediment transport. These two current meters will be in-situ for a period in excess of 6 months with three servicing periods, one of which has already been accomplished. The second servicing period is scheduled for the week of 15 July 1985. Present plans require removal of the current meters on or about 15 November 1985. A copy of the field log is provided in Appendix A.

The purpose of this report is to present the results of the geophysical survey (i.e. side scan mosaic, bathymetry and isopach (sediment thickness) in a series of overlays in order to select an optimum cable route from shore to the 600 foot isobath. In addition, the synthesis of these data and the results of the wave and current observations will enable the selection of a cable junction point.

Two sets of charts are provided with this report under separate cover: a set of three 1:8400 scale chart comprised of a sidescan mosaic with bathymetry and isopach mylar overlays; a set of ten 1:2400 scale sidescan mosaics, with ten bathymetry and seven isopach mylar overlays.
2.0 BACKGROUND

During the early stages of the SOAR effort, two previous exploratory surveys were conducted, the results of which provided a basis for the survey presented in this report.

The first survey, conducted by the Naval Oceanographic Office (NAVOCEANO) under the direction of NUSC, Newport, found that a direct route between West Cove and the SOAR Range was not feasible because the inshore portion of the route was 'blocked' by a rock ridge lying within the depth of storm wave action. A less direct but more suitable route with regard to bottom conditions was suggested, namely SSW from West Cove for about 2 1/2 nautical miles then westerly to the SOAR area.

The second survey, conducted by CHESDIV, was concerned with an investigation of two possible nearshore cable approaches to SCI; West Cove and Northwest Harbor. Bottom conditions at both sites were investigated by divers from about 20 fathoms shoreward and depth survey lines were run using a fathometer and a line-of-sight positioning system for positioning control. Additional geotechnical information was also obtained at West Cove for assessing cable burial ashore. Based on this study West Cove was recommended as the best of the two sites for a cable landing area.

The results of these two reconnaissance surveys led to the conclusion that West Cove would be the best cable termination point and that a detailed geophysical survey of the offshore area should be accomplished in order to provide planning data for installation of underwater cables.

3.0 SURVEY SYSTEM

3.1 SAIC NAVIGATION AND DATA ACQUISITION SYSTEM

The SAIC Navigation and Data Acquisition System was used in conjunction with the Del Monte Trisponder, to provide navigational control for the entire survey. In addition, all bathymetry data were recorded on data disks and later analyzed using the same computer system. The SAIC system consists of an HP 9920A microcomputer interfaced to a dual disk drive, printer and plotter. Environmental systems are interfaced via RS232C or BCD interfaces. SAIC's comprehensive software package controls the entire system, but is designed in a modular fashion to permit the operator to set-up and control the survey specifying data acquisition parameters such as recording, printing and plotting intervals. The system also provides steering guidance during survey operations. The system has been used extensively for all types of surveys including vessel, submersible tracking and cable laying operations.
Specifications of the SAIC system are presented in Appendix B.

3.2 POSITIONING SYSTEM

A Del Norte Model 540 Trisponder was used to position the vessel during the survey. Operating in the X-band portion of the radio frequency spectrum, the Trisponder system provides position accuracies of 2 to 3 meters to line-of-sight ranges.

The positioning system was calibrated on SCI prior to installation aboard the Research Vessels using horizontal control data provided by NOSC, San Diego.

The control points used for the calibration were the same ones used for the survey operations off West Cove. These points are:

- LAMAR #1
  - N 316921.68 ft.
  - E 1278554.83 ft.
  - Elevation 32 ft.

- CAPITAINE #3
  - N 317612.03 ft.
  - E 1282827.48 ft.
  - Elevation 130.25 ft.

The calculated baseline distance between these two control points is 4329.15 feet (1319.86 meters). With the shipboard Master and DDMU installed at Capitaine #3 and the Remote transmitter/receivers installed at LAMAR #1, the calibration values were determined so that the range between the Master and the Remotes read 1319.9 meters. After completion of the calibration, remote T/R's were installed at Capitaine #3 and LAMAR #1 and the Master T/R and DDMU were installed aboard the research vessel.

A data sheet for the Model 540 Trisponder is presented in Appendix C.

3.3 BATHYMETRY SYSTEM

An Edo Western bathymetry system was used to obtain depth data for the entire survey. Although a Raytheon DSK19R with an SSD100 Digitizer was available and used for the first two days aboard the IX 506, after transfer of equipment and personnel to the R/V EGABRAG III, the EDO-Western system was used exclusively for the survey. The decision to use the EDO system was based on the availability of a hull mounted transducer provided by NUSC. Otherwise mounting of the transducer to the side of the vessel would have required extensive fabrication and welding to provide a secure installation.

The 24kHz bathymetry system consists of an Edo-Western Model 615 graphic recorder, a Model 261C Digitrak and a Model
sonar transceiver and is capable of measuring depth to about 2000 feet as configured. Greater depth capability can be attained using lower frequency transducers. The output of the Diqitra is interfaced to the navigation computer for recording depth in conjunction with ship position.

Specifications for the EDO system are presented in the Appendix D.

3.4 SUBBOTTOM PROFILER SYSTEM

An ORE Geopulse subbottom profiler system was used for determining the thickness of bottom sediment throughout the survey area. The Geopulse system generates a sharply defined wideband high acoustic source level which can penetrate into the seabottom. Reflections from layers or strata of differing density are received by a hydrophone streamer and displayed on a graphics recorder. The graphic records obtained portray the bottom layers on a known time base and when combined with the velocity of sound for the particular bottom material provides a measure of sediment thickness.

The Geopulse system consists of a lightweight catamaran assembly that contains the sound source, a hydrophone streamer for receiving the reflected signals and shipboard electronics for controlling, filtering, processing and recording the outgoing and incoming acoustic signals. The return signals are displayed on a graphics recorder and also recorded on analog tape for archiving and/or reprocessing.

During the subbottom survey the location of the sound source and hydrophone streamer were measured in relation to the shipboard navigation antenna so that position of the vessel (antenna) could be translocated to the Geopulse system during the analysis phase.

Specifications of the Geopulse System are provided in Appendix E.

3.5 SIDESCAN SONAR SYSTEM

An ORE Model sidescan sonar system was used to obtain acoustic images of the sea bottom over the entire survey area. Survey lines were set-up and the range scale of the sidescan was such that approximately 150% bottom coverage was obtained.

All sidescan data were recorded on analog tape for subsequent playback and processing for development of bottom mosaics.

The sidescan system consists of a towfish and a graphic recorder for displaying the sonar images of the bottom. The very short (100 kHz) pulses emanating from the towfish are beamed across the seabed and are reflected from the seafloor and fro-
objects on it to produce images on the recorder. The recorder and towfish are coupled by an armored tow cable to a winch equipped with slip rings. The depth of the towfish is normally maintained at ninety percent of the water's depth. The distance above the bottom is maintained by a combination of ship's speed and amount of cable paid-out. Normal surveying speed is generally 5 - 6 Kts.

Specifications for the sidescan system are presented in Appendix F.

3.6 CURRENT METER INSTRUMENTATION

Two current meters attached to tripods were deployed in West Cove on 24 April 1985 for a planned 6 month deployment. Divers securely mounted the tripods to the bottom with chain and anchors extending from each leg. Spirit levels on each tripod permitted the diver to level the tripods and to observe if any settling had occurred between servicing periods.

Each assembly was equipped with two acoustic locating beacons; one on the current meter and one on the tripod which were used for locating each unit during the servicing periods. In addition, the beacons provide a means of locating the units in the event they are moved by fishing boats that frequent this area.

Both current meters are manufactured by Sea Data Corporation, Newton, MA. The shallow current meter is a Model 621 Directional Wave Current Meter (DWCVM) which uses a two-axis electromagnetic current sensor for the current measurement and a quartz pressure transducer to record wave pressure fluctuations. The sophisticated internal data logger permits a variety of sampling schemes, vector averages wave measurement scans and formats the data for recording on the internal cassette.

The deep current meter is a model 635-12 Directional Wave and Tide Recorder that provides basically the same capabilities as the Model 621, but in addition measures temperature.

Specifications for these current meters are provided in Appendix G.

3.7 RESEARCH VESSELS

The Navy initially provided a modified 140 foot landing craft (IX506) for conducting the field surveys. All survey equipment was installed aboard IX506 dockside at NOSC, San Diego, and survey operations commenced off West Cove on 24 April 1985. Several serious problems arose during the early portion of the operations resulting in IX506 returning to NOSC, San Diego on the 26th of April. At that point, a decision was made to transfer equipment and scientific personnel from IX506 to PGARRAG III in
order to complete the survey operation and to meet schedule requirements for the SOAR transponder implant operations scheduled for the period immediately following the survey operations.

While aboard IX506, a partial geophysical survey was accomplished and two tripod mounted current meters were installed. The R/V EGAHRA III was used for the entire survey (repeating the survey started aboard IX506), including servicing of the current meters at the end of the SOAR transponder operations.

4.0 DATA ANALYSIS PROCEDURES

Four basic data sets were obtained during the survey: position, sidescan, bathymetry and subbottom. The first data set is common to the other three, so that the results can be presented in a series of charts depicting the respective parameters as a function of position. Each data set has been analyzed according to the general procedures discussed below and the final products consist of a sidescan sonar mosaic which forms a base chart for overlaying the bathymetry and isobath charts. Using semi-transparent mylar base, the bathymetry and isobath data can be readily assessed in relation to the sidescan acoustic image of the bottom. The presence of rock outcrops and other bedforms in relation to depth and sediment thickness is immediately apparent and provides an efficient method for detailed planning for the inshore portion of the SOAP cable installation project.

All the survey data sets were obtained simultaneously with time, position and depth recorded on the SAIC navigation system. An automatic time marker was connected to both the sidescan and subbottom recorders and synchronized with the computer clock resulting in a reference time base for the data acquisition process.

The sidescan mosaics and all overlays are plotted at identical scales using the Lambert Grid for California Zone 6 with coordinate values in feet. Figure 4-1 shows the ship's track coverage of the survey area. Line spacings varied from about 50m in the Northern part of the survey area to about 100 meters over the Southern shelf and slope areas.

The following sections describe in detail the general procedures for processing the data sets into overlay charts.
Figure 4-1. Ship's Track Coverage of Survey Area.
4.1 SIDE SCAN MOSAIC

The analog data tapes recorded during the sidescan sonar survey were processed to remove water column, slant range and scale distortion associated with varying ship speed. The scale distortion is corrected by utilizing navigation information whereas water column and slant range are removed using special processors. The 'corrected' tape was played back through the graphic recorder creating sonar images of the bottom without speed distortion and these images were mounted in mosaic form providing an acoustic picture of the entire survey area. The original mosaic, being physically large, was separated into ten plates and each plate was photographically reduced to a scale of 1:2400. An additional mosaic was photographically produced at a scale of 1:8400 which results in a reasonable document size that portrays the entire survey area and is manageable for presentation and general overview discussions. The 1:2400 scale mosaics cover the same area as the 1:8400 mosaic in 10 plates, but provide more detail for precise planning of cable routes and specifying a location for the junction box. Figure 4-2 shows the distribution of the 1:2400 scale plates in relation to the 1:8400 chart.

During the processing phase, the setback or translocated position of the towfish, relative to the positioning system antenna located on the bridge, was determined so that the correct position of the towfish was utilized during development of the mosaics.

4.2 BATHYMETRY

The bathymetry data was recorded simultaneously as a function of position on magnetic disks using the SAIC Navigation and Data Acquisition System. During the processing phase, corrections for transducer draft and tidal elevation were applied and the corrected data were edited for spurious or erroneous values. Tidal elevation corrections were applied by plotting the tidal curve covering the entire survey period (obtained from the NOAA Tide Tables) and digitizing the tidal elevation signature at one hour intervals. The digitized tidal data were input as a 'look-up' table which was accessed by the computer to provide interpolated tidal elevation at the time of each discrete observation. A transducer draft correction of 7 feet was applied to all the depth data.

Editing of spurious or erroneous values was accomplished by converting the binary format field data disks to a text file format. The text file format permits the analyst to access any or all data contained on the disk and to edit or remove invalid data. After completion of the editing procedure, the edited text file disks are converted to new edited binary disks and then plotted at the desired scale. The original data disks are not changed in any way.
Figure 4-2. SIDESCAN SONAR MOSAIC INDEX MAP
The bathymetry is plotted on a series of charts at the same scale as the sidescan mosaics, namely 1:8400 and 1:2400 in 10 plates. The data are plotted on translucent mylar using waterproof ink and the mylar provides a stable base material which minimizes grid distortion due to temperature and humidity.

All depth sounding on the bathymetry charts are referenced to the standard chart datum for the United States West Coast, Mean Lower Low Water (MLLW).

Each sounding chart has been constructed using different colors to depict different depths in 100 ft. intervals. For example, all depths lying within 0 - 100 ft. are plotted in one color, while all depth within 101 - 200 ft are plotted in a different color, and so on. From the composite bathymetry chart (1:8400 scale), one can readily see the contours formed at the color boundaries. Likewise, the rather abrupt change in bottom gradient at the shelf break is also readily apparent.

Finally, it should be noted that the 1:2400 scale bathymetry charts have been plotted so that a small portion of each chart overlaps each adjacent chart. Consequently, alignment of adjacent charts is easily accomplished by aligning the actual soundings.

4.3 ISOPACH ANALYSIS

The sediment thickness or isopach values were obtained from the subbottom profile records by measuring the one-way travel time interval between the sediment-water interface and the first acoustic horizon or isopach contact. These travel time values were determined along each survey line at intervals of 30 sec. to 1 minute corresponding to 300 feet and 600 feet of distance over the bottom between observations. These time-values were multiplied by an assumed speed of sound in packed sand of 1650m/sec (URICK, 1975) to obtain the thickness of sand. These values were merged with their respective positions and plotted in the same manner as the bathymetry data (i.e. sediment thickness as a function of position). A representative subbottom profile record for the central and north portion of the survey area is shown in Figure 4-2a, which shows the presence of a proposed sand lens extending from a rock outcrop at the left of the figure. In contrast, Fig 4-2b shows the steeply sloping bedforms which occur in the southern portion of survey area and are noted on Figure 5-1.

The isopach values are presented in feet (below the sediment-water interface) and are plotted at both 1:8400 and 1:2400 scales and overlay the base sidescan mosaics.

The isopachs are also plotted using different colors to represent each 10 feet of sediment thickness. The 1:8400 scale chart has been hand contoured to depict the distribution of sand
Figure 4-1a: Example of a seismic record showing a sand lens.
       600 FT
       130 FT
       SAND
       SOPACH CONTACT
       FIRST MULTIPLE

SAIC
Figure 4-1b. Example of steeply sloping bedforms in the area noted on Figure 5-1.
4.4 CURRENT VELOCITY

The two current meter data tapes retrieved at the end of the SOAR transponder implant were sent to Sea Data Corporation for transcription from cassette to 9 track tape. Both records have been transcribed (at different times) and each record contains nearly 20 days of wave data (significant wave height), current speed, pressure (tide), temperature (degrees C), and U, V components of the current velocity. Plots of these data are presented in the following section.

At the conclusion of the field current measurements program scheduled for early November 1985, a detailed analysis of the current velocity and wave data will be completed and forwarded to CHESDIV. However, the data obtained during the servicing periods will be reduced and informally summarized.

The location of the current meters is shown on Figure 5-1 below.

5.0 RESULTS AND DISCUSSION

The following discussion assumes the reader has available the 1:8400 scale charts comprised of the sidescan mosaic and the bathymetry and backscatter overlays that have been provided with the report but under separate cover.

Figure 5-1, a side scan mosaic of the survey area, shows a predominately sand covered bottom with extensive rock outcrops fringing West Cove (to the North) and the western boundary of the survey area. Extensive kelp beds are present off Wilson's Cove and utilize the rock outcrops as an attachment substrate to depths of about 125 feet. The kelp does not generally grow at greater depths even though rock outcrops are present. There are two narrow sand covered channels at the extreme northerly part of the survey area adjacent to the West Cove Beach. They are sand covered and offer potentially good areas for the short-ward portion of a cable route. However, the channel located on the eastern part of West Cove leads to a small rocky bluff which might require rock excavation if this approach is used.

Water depth in the survey area varies from about 30 ft. in the extreme northern part to about 400' at the shelf edge, three miles offshore, after which the bottom gradient increases dramatically. Bottom gradient in the survey area is about 1-3%, whereas beyond the shelf break the gradient increases abruptly to about 20%.

In the central part of the survey area, several rock
Figure 5-1. West Cove Survey Area
outcrops are obvious, exhibited by the discrete dark areas on the side scan mosaic. Here the sand thickness is generally very thin amounting to less than 1 foot. In the east central part of the survey area rather dense but relatively small reflectors is more likely debris; however, based on the isopach analysis, it appears to be that these are remnants of a rock outcrop because the surrounding sand thickness is minimal (the order of 1 foot). Whereas, to the north of this area the sand thickness is over 60 feet.

The greatest sand thickness occurs in the northern part of the survey area and exceeds 80 ft., only 2500 feet off Wilson’s Cove. The isopach analysis shows a small submerged sand-ponded valley, trending southeasterly across the northern part of the survey area and in an arc parallel to Wilson’s Cove.

The central and south portions of the survey area have a relatively thin overburden of sand. The subbottom records for the southern portion of the survey, inshore of the shelf break, depict numerous, steeply dipping bedforms (Fig. 4-2b) which rise to or very near the sediment-water interface. Between these bedforms may be several tens of feet of sand. These bedforms are most noticeable in water depth of about 300 ft. where the potential for wave-induced bottom currents and therefore sediment transport is negligible.

At the shelf break, several parallel rock outcrops, devoid of sand are noted on the side scan mosaic.

The data obtained from the current meters in Wilson’s Cove are shown in Figures 5-2, 5-3, 5-4, and 5-5. Figure 5-2 shows the significant wave height (height of 1/10 highest waves) and pressure variance. At the shallow site significant wave height was about 75 cm at the beginning of the period and gradually decreased to about 50 cm. At the deep site a similar trend is noted, but the wave height is about half that at the shallow site. This difference in wave height is the result of the waves becoming steeper and higher as they ‘feel the bottom’ at the shallow site.

The U, V velocity components at the two sites are shown in Figure 5-3. There is virtually no mean current at the shallow site, but the deep site exhibits a very slight mean westerly current (-U) of about 4 cm/sec.

The maximum speed (orbital velocity) for each one-hour burst interval is shown in Figure 5-4. At the 10m site, maximum orbital velocities approach 100 cm/sec and follow a decreasing trend over the 20-day period averaging about 35-40 cm/sec over the last half of the record. These speeds are almost wholly associated with wave dynamics because no mean flow was observed.

At the deep site, the maximum speed showed the same trend, but the maximum observed speeds are about 60 cm/sec decrease to about 30 cm/sec over the remainder of the record.
Figure 5.2. Significant Wave Height and Pressure variance at the shallow and deep current meter sites.
Figure 5-3. U, V Velocity components at current meter sites.
Figure 5-4. Maximum speed per burst interval and kinetic energy.
Figure 5-5. Tide and temperature at the Current Meter Sites.

JULIAN DAYS 1985
DAY 110 IS 4/20/1985
Figure 5-5 shows the tidal elevations observed at both sites. Note that the ordinate scales for pressure are not identical. Bottom water temperature at the deep site shows fluctuations of 1 to 30 C that correlate with the tide. Average bottom water temperature is about 170 C.

A more detailed analysis and interpretation of these data will be provided when the sampling program is complete. This will include, but not be limited to duration and recurrence statistics, wave energy spectra and the relationship between these parameters and the potential for sand transport.

6.0 CONCLUSIONS

The West Cove of San Clemente Island is surrounded by rock outcrops around the periphery of the Cove except for two relatively narrow sand covered areas that tend toward the shore. Seaward of the Cove the entire bottom is sand covered with the greatest sand thickness (exceeding 80 ft.) 2500 to 3000 ft off the Cove. The remainder of the survey area has a minimal sand thickness of the order of 1 to 2 feet until the shelf break in the southern part of the survey area where rock outcrops and bedforms either reach or penetrate through the sediment water interface. Along the slope where gradients are of the order of 20%, virtually the entire bottom is exposed rock and devoid of sand.

Based on this survey, a cable route from West Cove to the shelf break is suggested over those areas where sand thickness is the greatest and surface or nearsurface bedforms are not present. It is however, recognized that in water depths greater than about 200 feet, dynamic wave-induced currents will be minimal and the local mean currents are probably not strong enough to initiate sand movement. Consequently, the most direct route may be the best route for the cable in this portion of the study area.
4/21/85

Arrived NOSC Post 7 at 0730. Expected Shaker Express to deliver equipment at 0800.

Drove to SB Airport and found Shaker was going to deliver on Monday at 0800. Finally had delivery at IX 506 by approximately 1030 a.m.

Picked up CM (635-12) at United air freight and then met Morton and Brennan at the airport.

Returned to IX 506 at approximately 1500 and completed installation by approximately 1930 hrs.

4/22/85

Arrived at North Island at 0845. Checked in and met Jay Bercaw. Del Norte equipment manifested on same flight. Take off from North Island at 1000.

Arrive SCI at 1030. Check into personnel trailers at 1130. Meet in conference room at 1200.

Attendees:

Neil Lantham  NOSC Test Coordinator
Jay Bercaw  MariPro
Frank Wyatt  NUSC
Keith Cooper  CHESDIV
Ed Saade  Pelagos
Mike Brennan  SAIC
Gerry Cook  SAIC
Robert Morton  SAIC
Mark Silvia  SAIC

Discussed overall survey plan and determined coordinates for survey set-ups.

Calibrate Trisponder between LAMAR1 and CAPITAINE #3.

Trisponder Cal.

LAMAR1  N 316921.68
        E1278554.83

CAP#3

Baseline  4328.06 ft. (flatplans)
        4329.15 actual = 1319.86 m = 1319.9

LAMAR1 - CAP#3 (MASTER)  (824)  2095.0
CAPITAINE #3 ELEVATION  130.25 + 6 = 136.25

LAMAR#1 ELEVATION  36.25 approx.  36.25

30.2 PAD 1 start range  100.00 ft.
correction  =  33 m

Installed LAMAR#1 1500 hrs. approx. - will correct
batts tomorrow

<table>
<thead>
<tr>
<th>764</th>
<th>792.2</th>
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<tr>
<td>824</td>
<td>774.3</td>
</tr>
<tr>
<td>924</td>
<td>778.8</td>
</tr>
</tbody>
</table>

- LAMAR 1

Bearing

<table>
<thead>
<tr>
<th>CAPITAINE #3 to op. area</th>
<th>137° M</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAMAR#1 to op. area</td>
<td>170° M</td>
</tr>
</tbody>
</table>

4/23/85

0645

Cook, Wyatt, & Brennan - Pick up 4 spare
batteries and powered-up LAMAR & CAPITAN.
(Spare batters at each station)

Left spare Trisponder (code 764) at operations

0745

U/W from dock to IX 506 via launch. U/W for op.
area.

Checked out sidescan, but had problems with kelp
- one channel inoperative (port) but Ed Saade
found and corrected a miswire. Unable to get
good side scan record from beach out.

Kelp also fouled 200 KC transducer mounted in
Moon pool - This happened several times. Ducer
mount was re-rigged by Brennar to elevator
frame- transducer pipe looks okay at full speed
(8 kts)

Rigged current meter tripods and set each
current meter as noted in the tech log. Silvia
had to grind a larger diameter for each mounting
plate so that the pressure case welds would pass
through the plate.
Experienced some phase cancellation of Del Norte System - may be because we're operating too close - we're not sure what the problem is, but intend to check antenna bearings upon arrival dockside.

Boston Whaler over the side with two Navy operators in preparation for supporting the current meter (30') implant dive ops.

Shortly thereafter - Whaler went aground ashore - one sailor injured both feet - Bercaw & Wyatt swam ashore and got the Whaler outside a (mild) surf zone. The IX 506 stood off and Silvia swam in with a line-attached it to the Whaler and the IX crew pulled in the Whaler. The Whaler was smashed on the hard chives, but not holed. After the Whaler was aboard IX, we connected the gas line and started the engine. It ran fine, but would not turn the prop when engaged in forward gear.

1610 PST  U/W for Wilson Cove to transfer injured sailors ashore.

1721 PST  Arrive Wilson's Cove. Attempting to get another small boat, Zodiac for example - for support during ops. tomorrow. - Pelagos will provide.

Decided to change location of Master from T. Towers above the Moon pool to the after main mast on IX 506. Will do this at Wilson Cove. Transferred Master to main mast and added an additional 50' of Pwr. Sig. cable in order to reach DDMU in the lab. Gave Bercaw spare CM batts and two cassettes tapes for CM turnaround.

4/24/85

0609 PST  Buoy detail.

0630 app.  U/W for op. area.

Day Plan
Pelagos will ship a Zodiac & motor via Jim's Air - arriving at SCI at 700. Wyatt & Bercaw will assemble on beach at West Cove and rendezvous with IX for current meter implant. Will install deep CM first - followed by shallow CM. Following CM implant will commence shallow seismic work of near shore area. Note: Wyatt will check bearings of shore stations as per LAMAR #1 - 170° M
With Master on top of mast - we should have no problems with phase cancellation or drop outs.

Filled metal bucket (with plastic lines) with fresh water and placed 621 sensor head in water for a soak. CM should sample at 0700.

'Deep' CM in water. (See Note)

Shallow CM in water.

Note: Pelagos (via Wyatt) sent Zodiac to SCI. Wyatt/Bercaw rigged on beach and rowed to IX. CM implant commenced and Zodiac provided diver support.

Divers: Wyatt, Bercaw, Silvia

Commenced Geo/3.5/Bathy Survey of area offshore. Kelp line. First-outlined seaward extent of Kelp beds and then commenced line surveys.

4/25/85

Staff Meeting

Reviewed Geo & 3.5 Records

1800 - 10 lines at 200 line = 200 M
5 hrs. to complete shallow seismic

Side Scan

1100 Arrived NOSC pier SD

1101 Engine Room Fire aboard IX 506

Spent afternoon making arrangements with Bill McKune, etc. regarding use of Egabrag III in lieu of IX 506. Because of fire in IX, not ready until Tuesday. Decision made by 1700 - Visited Egabrag III for ship check - Met with Capt. Ray Wilson. Vessel very clean and very well equipped.

Tech party broke down all equipment aboard IX for transfer to EGAGRAG III.

Agreed with Capt. Wilson for him to bring Egabrag III alongside IX 506 for equipment transfer at 0700 4/26/85.

All hands spent night at King's Inn.
0700 At NOSC - transferred all Pelagos & SAIC equipment to Egabrag III - then returned to Egabrag III berth and completed installation.

1610 U/W for SCI op area
Testing Sonotech transducer interfaced to EDO.

1830 + Determined that EDO/Sonatech system capable of operating to about 1700 ft. at 8.5 kts.

ZULU Time

1413 Powered up EDO & DNTI - All okay. Set up for SS/SB/Bathy for 21 lane survey. GEO-Shallow

1507 Geopulse & Side Scan in water.

Ed suggested we use Geopulse and tap off 3.5 KHZ - if that provides good records then we won't need 3.5 KHZ fish.

1515 Changing Hydrophase for Geopulse - It was apparently damaged on the IX 506.

1520 Start Line#9 GEO-SHALLOW

1550 Restart Line#10

1610 appr. Complete Line#10

1620 Start#11
1630 appr.  824 TR off
Contact Chuck via Radio to change batteries at both stations.
1659  New batteries on line
1709  Resume Line#11
1715  End (early) line#11 - Kelp Bed
1718  Start#12
1752  Start#13
1806  End#13
1812  Start#14
1829  End#14
1838  Start#15
1851  End#15
Clean Kelp from Geo & S/S
1901  Start#16
1920 appr.  End#16
    End Survey at 2122 hrs.
2307  Start SS/SB WQC/SSL Run#1 End course 250
2400 appr.  End Set up Offset 300' East of previous line

0038 Z  SS/SB WQC/SSL Run 2
    Start course  075° T appr.
    Dogleg Course
0125 Z  Complete 2nd WQC/SSL Run
0130 Z  Commence Run out to Shelf Survey Area
0147 Z  End Line#3
0248 Z  Start Shelf Survey
0302:30  EOL#1
0420 appr.  Completed 4 lines of shelf survey

4/28/85
0430 Z U/W for Wilson’s Cove
1449 Z 1) Kelp Boundary Survey
       2) Outline seaward boundary of kelp beds.
1456  Commence boundary run
1519  Start Beach Run#1 Course 215°-218° T
1525  End Beach Run#1
1608  Start Beach Run#2 Course 210°T appr.
1632  Start Beach Run#3 Course 200° T
1641  End Beach Run#3
1657  Start Beach Run#4 Course 190° T
177?  End Beach Run#4
      Start Beach Run#5 Course 225° T
      End Beach Run#5

1740  Launch small boat and divers for CM Inspect. & Bio bottom samples
      Rig for 2nd Kelp boundary run

1944  Start run SS/SB/Bathy around offshore boundary of Kelp
Pick up small boat

2059  
Set up CBL Route Survey

2100 appr.  
Start cable Rt.#1

2200  
End

Start CR#2
End CR#2
Start CR#3

4/29/85

0016:50  
End CR#3
Start CR#4
End CR#4

Set up survey for completion of shelf survey and slope survey at twice the previous line spacing 600 ft. vs. 300 ft.

Plan to work until about 0400Z then tie up at Wilson's Cove for the night and complete survey tomorrow AM

Finish line 10(6) then RON Wilson Cove. Return to op. area tomorrow and complete shelf survey and slope survey.

Monday  29  +  Finish Survey
Tuesday  30  +  Offload Pelagos - Ship
               SAIC Gear
Wednesday  1   SCI Trispo set-up
Thursday  2    Egabrag III sails for SOAR

1327 Z  
GEO/SS in water - NAVDAS on line =305 ft.

1335 Z appr.  
Resume Shelf Survey - with line 11 (7)

1345 Z appr.  
End Line 7/11

1411 Z  
End#12

1421  
Start#13

1431  
End#13
Start#14

30
1505 appr.  Start 15 (Last Line)
1517 Z  End 15
Set up Slope Survey
Lane 253° T
1540 Z  Read for start of Slope Survey
Lane bearing at start 253° T
1549 Z  Start 1
1603 Z  End 1
1720 Z  End Slope Survey
Inshore Survey Ops. Complete

Monday 29 April
Depart Egabraq III at SCI approx. 1200 PDT
Check out Trispo stations for SOAR project
To SD via Air Resorts, arrive 1700 PDT to King's Inn

Tuesday 30 April
Offload SAIC Bathygear and pack for return shipment
Visited Pelagos to discuss SS ?? and other data products

Wednesday 1 May
To SCI with F. Wyatt - Set up station FRANK - No charged batts available so briefed John Thorton (Chesdiv) about station set up - Returned to SD 1700 approx.
Integrated Navigation & Data Acquisition Systems

Firmware Modules For Interfacing Short, Medium & Long Range Positioning Systems.
Integrated Satellite And Acoustic Navigation Techniques.
Accurate & Precise Field Verified Navigation Techniques.
Multi-Ship Tracking, Navigation Control And Reconstruction.

Direct Applications For:
- Bathymetric Surveys
- Side Scan Sonar Surveys
- Search & Salvage Operations
- Repetitive Bottom Sampling
- Geophysical Surveys
- Ocean Disposal Operations
- Mooring Deployment & Retrieval
- Multi-Ship Control
- Exercise Reconstruction

Video Display of Waypoint Navigation
General Features of the SAI Integrated Navigation & Data Acquisition System

**INPUT**
- Multi-System Interface
- Hyperbolic, Range/Range, X, Y, Gnd
- NAVSAT
- Acoustic
- Environmental Data (Digital & Analog)

**POSITION CALCULATIONS**
- De-Skewing
- Editing
- Simple Fix
- Multirange Fix
- Integrated Fix (Kalman Filtered, Fix Quality Residual Analysis)

**NAVIGATION CALCULATIONS**
- Kalman Filtering, Editing
- Speed/Course Made Good
- Range/Bearing (To A Point)
- Offset/Distance (Along Computed Line)

**PROJECTIONS**
- Local - X, Y
- Transverse Mercator - X, Y, Lat/Long
- Universal Transverse Mercator - X, Y, Lat/Long
- Mercator - Lat/Long
- Lambert - X, Y, Lat/Long

**DISPLAYS**
- Video
- Alphanumeric
- Graphics
- Transit Mode
- Survey Mode
- Cartography

**RECORDING**
- Plotted
- Ship Track
- Multi-Ship Track
- Cartography
- Precalculated Survey
- Multi-Destination Points

**SPECIAL FUNCTIONS**
- Display Controls
- Recording Controls
- Navigation Controls
- Analysis

For further information, please contact:
Science Applications Inc.
Ocean Science and Technology Division
370 Thames St.
Newport, RI 02840
(401) 847-4810
Designed to work with existing Thunder Master Remote units, this DDMU represents another advance in technology for our family of positioning systems. Microprocessor controlled, this DDMU carries many of the tried and proven outstanding characteristics of the 80 km Transponder system: portable, rugged, low current drain, reliable. Also by using the existing transponders, its same features are the part of the system.

Several significant changes have been made. For example, instead of the CRT display, the DDMU is a programmable and easy-to-read printed form of the data. It is helpful in the readability and presentation of data you might want to see all at the same time. Also made the simplicity of the front panel. For operational ease, it has only a power switch, keyboard and an intensity control for the CRT.

Of special significance, Del Norte has overcome the most common criticism pertaining to range-range type systems. The DDMU automatically presents the range data, whether 2, 3 or 4 different ranges, despatched to the same point of time. All data is displayed as being simultaneously acquired, thus overcoming time lags from boat movements between and during ranging sequences.

All data stored in the non-volatile memory, such as calibration factors, limits, update rate, position for multiple user site range conversion, site and vessel against power failure and maintained for about 30 days using internal batteries.

The Model 540 DDMU also contains self-test circuitry for checking all the way to the output connector.
MODEL 248E SOLID STATE SONAR TRANSCEIVER

The Model 248E is a versatile, compact shipboard transceiver featuring extremely low input power reliable solid state operation and a broad range of output power and frequencies. Because it incorporates a unique receiver which combines Automatic Gain Control (AGC) with Time Varying Gain (TVG), multiple frequency operation and multiple bandwidth features in a single unit, it will perform a wide range of oceanographic and survey tasks. The Model 248E can be used as a modular building block for:

- Depth Sounding Systems
- Subbottom Profiling Systems
- Navigational Systems
- Acoustic Command Systems

This rugged solid state sonar transceiver was developed by the designers of the widely used AN UQN 1 and the AN UQN 4 Depth Sounders and incorporates all of the design concepts used in the thousands of transceivers built by Edo Western. Specific customer requirements are met through a choice of operating frequencies from 3 to 40 kHz, continuously variable manual control of output power to 2,000 watts, internally or externally controlled pulse lengths, and compatibility with all precision recorders as well as with a wide variety of standard transducers. An MTBF of greater than 5,000 hours has been demonstrated in over four hundred Model 248 series Transceivers in the field. The Model 248E mounts in a 19" standard relay rack, but metal cabinets and metal or fiberglass carrying cases are optionally available.
The Model 248E is unique in that it offers an operator the greatest degree of flexibility of any transceiver available on the market:

1. Variable power
   0 to 2000 watts (10,000 watts optional)

2. Three operating frequencies
   3 to 40 kHz selectable (100 kHz optional)
   over a 2 to 100 ms pulse

3. Four receiving modes
   TVG, Fast AGC, Slow AGC, Manual
TRANSMITTER

Output power can be controlled from 0 to 2000 watts by the POWER control. The output circuits are protected from damage due to accidental overload, overvoltage, or excessive pulse length—an overloaded reset control is provided on the front panel. Three standard pulse lengths, 3, 1, and 4 ms, are normally provided by a PULSE WIDTH selector for most common applications with Echo systems. Other pulse lengths are available on request over the range of 2 to 100 milliseconds. A MANUAL TRANSMIT key is provided for test purposes with a transmit indicator lamp.

The Model 248E Transceiver is designed to accept a 10,000 watt power booster assembly as shown on Page 5 when additional output power is required. A HIGH LOW POWER SELECTOR switch is provided on the front panel to switch this booster in.

FREQUENCY SELECTION

The Model 248E is normally provided with one operating frequency, available from the standard frequencies given in the performance specifications. Up to three operating frequencies in the range of 1 to 100 kHz can be made available as an option with the FREQUENCY selector control. The bandwidth of the receiver is normally 1 kHz, which optimizes performance for the Medium pulse length. Other bandwidths can be provided. The four position FREQUENCY selector switch can be used to select any combination of three frequencies and/or four bandwidths.

RECEIVE MODES

Four receiving modes are provided in the standard unit:

<table>
<thead>
<tr>
<th>Mode</th>
<th>Typical Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>TVG</td>
<td>Sub bottom profiling</td>
</tr>
<tr>
<td>Fast AGC</td>
<td>Real time location</td>
</tr>
<tr>
<td>Slow AGC</td>
<td>Bathymetry operation</td>
</tr>
<tr>
<td>Manual</td>
<td>Wide range of miscellaneous operations</td>
</tr>
</tbody>
</table>

In addition, a special front panel indicator is provided which is the operator when the receiver is set high and the output is going into saturation. This feature is particularly useful when operating with a wide range of recording devices, such as hard copy, magnetic tape recorders. Saturation should be prevented in the channel for high quality recordings.

A TIME VARYING GAIN feature is provided in the TVG and AGC modes which can produce the gain of the receiver 40 dB immediately after transmission and allows 100 milliseconds. This prevents the saturation of the receiver due to very strong signals when operating in shallow water in combination with the 60, 24 AGC. This feature provides virtual automatic gain control operation over a 100,000:1 change in signal level.

DELAYED TIME VARYING GAIN (TVG)

The Model 248E is used in a Sub bottom Profiling mode where the feature is used to reduce the gain in the receiver as the weaker echoes from the deeper sub bottom return to the recorder. A group of controls on the right side of the front panel performs this function in the following manner:

The delay of the TVG is delayed in time manually until the signal has reached the bottom. This can be monitored on the recorder by viewing the selected start pulse which marks the recording at the beginning of the TVG action. The delay range of this control is two microseconds to one second continuously adjustable by line and range controls.

Once set the delay controls need not be varied until the bottom echo changes significantly. To eliminate the receiver from the presence of echoes, the receiver is automatically reduced in gain by 40 dB over a time range of 2 to 100 milliseconds. The gain is then restored to the receiver gain set by the operator when used with the manual gain control. A normal display can be produced over a wide range of bottom return attenuations, characteristics, and depth readings.

FAST AGC

When the Model 248E is utilized to detect a higher intensity signal in a relatively noisy background, such as trying to detect a buried object in the presence of sub bottom reflected signals, the FAST AGC mode will normalize the background signal and emphasize the stronger signal. The gain of the receiver is automatically reduced during an automatic return cycle to keep the average signal return equal to the saturation. A short duration on strong echo will pass through the receiver with the no gain reduction thereby, creating a dark image in the presence of a subdued background noise level. The overall AGC range is 60 dB centered about some nominal manual gain setting which also permits a 60 dB gain variation in actual use. The AGC technique yields almost a total hands off operation over a very wide range of noise signal conditions.

SLOW AGC

When used in the deep water bathymetry mode, the SLOW AGC mode should be used to provide hands off operation of the system. In this mode, the AGC signal usually varies about ±1.5 feet. The transmission is transmitted due to the random movement of the ocean and the relative sound travel time to the target. The sound returns are averaged over a 10 second period and the overall gain of the receiver adjusts slowly to account for any average signal changes rather than rapid variations during single transmission/reception cycle. The overall AGC variation is provided as the same as for the FAST AGC mode.

MANUAL

A MANUAL mode is provided in the Model 248E receiver for use in those general purpose applications where operating conditions do not match the other three operating modes provided. In MANUAL, the front panel controls provide 100 dB gain variation and the manual 60, 24 AGC, the TVG feature is inoperative.

OTHER CONTROLS AND OUTPUTS

A Transmitter-Receiver selector is provided to permit normal manual operation or receive operation alone. Two very useful controls are available on the front panel: the range control can be used for a wide range of reasons, the KEY PULSE output and the REVERSE OUTPUT. The receiver output to the recorder can be selected in a FILTERED or UNFILTERED form. This feature is useful to optimize recording in a wide range of applications.
## MODEL 248E SOLID STATE SONAR RECEIVER

### PERFORMANCE CHARACTERISTICS

#### TRANSMITTER SECTION

<table>
<thead>
<tr>
<th>Power Output</th>
<th>2000 watts maximum; see Power Frequency graph on page 5.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Power</td>
<td>50 100 175 250 ohms</td>
</tr>
<tr>
<td>Duty Cycle</td>
<td>8%</td>
</tr>
<tr>
<td>Pulse Lengths</td>
<td>Short: 3 ms. Medium: 10 ms. Long: 40 ms. Other pulse lengths available from 2 to 100 ms. seconds on request.</td>
</tr>
<tr>
<td>Keying Rate</td>
<td>1200 pulses per minute maximum at the standard pulse length. Rate should be reduced when longer pulse lengths are used so as not to exceed specified duty cycle.</td>
</tr>
<tr>
<td>Frequency</td>
<td>Single frequency selected from the following standard frequencies: 3.6, 5, 12, 16, 24 and 34 kHz. As an option up to three frequencies can be chosen by front panel selector from the entire range of 1 to 100 kHz. See Power Frequency graph on page 5.</td>
</tr>
<tr>
<td>Keying</td>
<td>Remote contact closure, remote 2 volt pulse, or manual front panel push button. Overload circuits to prevent excessive output load current, excessive power supply voltage and excessive pulse length. Reset control on front panel returns operation to normal operation.</td>
</tr>
<tr>
<td>Protective Circuits</td>
<td></td>
</tr>
</tbody>
</table>

#### RECEIVER SECTION

| Frequency | Automatically selected with transmitter frequency. |
| Bandwidth | 3 kHz standard at standard frequency or to customer's specification when various pulse widths and frequencies specified. |
| Output Impedance | 50 ohms |
| Output Voltage | Greater than 5 volts rms. |
| Minimum Gain | 106 dB into a 500 ohm load. |
| Minimum Detectable Signal | Typical 1 microvolt in 1 kHz band at 3.5 kHz. |
| Receiver Modes | TVG, FAST AGC, SLOW AGC, MANUAL, see text for description. |
| Manual Control Range | 100 dB |
| Internal TVG | 40 dB gain variation in first 100 ms on TVG & AGC Modes |
| AGC Range | 60 dB centered around any gain control setting. |
| Variable TVG Characteristics | 2 ms to 1 second |
| TVG Start Delay | 2 to 100 ms |
| TVG Rise Time | 60 dB |

#### POWER REQUIREMENTS

| Primary Voltage | 115 VAC ± 10% |
| Primary Line Frequency | 50/60 Hz |
| Power | 25 watts quiescent in Receive Mode |
|         | 60 watts average in Transmit/Receive Mode |
|         | 600 watts peak demand after 2 kW transmission |


MODEL 248E SOLID STATE SONAR TRANSCEIVER

PERFORMANCE CHARACTERISTICS (Cont.)

PHYSICAL CHARACTERISTICS

External Connections
Type MS 31024 connectors in rear

Size
19" wide x 8" high x approx. 17" deep including connectors
48 cm wide x 22 cm high x approx. 43 cm deep

Weight
40 pounds. 18 Kg

OPTIONAL 10,000 WATT POWER AMPLIFIER

For Use With the Model 248E Sonar Transceiver

- 10,000 watts output
- Provides an additional sonar channel

INCREASED POWER

When the Model 248E transceiver is used for sub-bottom profiling or deep water bathymetric applications, the 10,000 watt power amplifier is often added to gain better penetration into the sub-bottom layers. Output from the 10,000 watt power amplifier is 12 kW as compared to 6 kW from the Model 248E transceiver alone.

ADDITIONAL SONAR CHANNEL

Because the optional Power Amplifier is a separate instrument, it has its own interface for connection to a transducer. This gives the Transceiver- Amplifier combination the possibility of being a dual-purpose system. Sub-bottom information could be obtained using a transducer connected to the Power Amplifier and a transducer better suited for deep soundings could be connected directly to the 248E Transceiver. A single switch on the front panel of the 248E selects which system is to be operated at any given time. The multiple frequencies available on the 248E gives even greater versatility to this combination. The front panel selector could also be programmed to change frequencies at the same time the transducers are changed, or separate switches could control frequency and output transducers.

POWER/FREQUENCY RELATIONSHIP

Maximum transmitting power is reduced as higher frequencies are selected as shown in this simplified logarithmic graph
MODEL 248E SOLID STATE SONAR TRANSCEIVER

AMPLIFIER SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Impedance</td>
<td>10 to 25 ohms</td>
</tr>
<tr>
<td>Maximum Duty Cycle</td>
<td>2%</td>
</tr>
<tr>
<td>Pulse Width</td>
<td>Selectable from Model 248E</td>
</tr>
<tr>
<td></td>
<td>120 msec maximum pulse width for full 10,000 watt output</td>
</tr>
<tr>
<td>Protective Circuitry</td>
<td>Output short circuit over voltage</td>
</tr>
<tr>
<td>Size</td>
<td>19 wide 57 high 14 deep including connectors</td>
</tr>
<tr>
<td>Weight</td>
<td>25 pounds (11.7 kg)</td>
</tr>
</tbody>
</table>

INSTALLATION DATA

OPTIONS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Size in inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 248E Cabinet</td>
<td>28235 3</td>
<td>9.31 high x 21.69 deep x 19.75 wide</td>
</tr>
<tr>
<td>Model 248E 10 KW Amplifier Cabinet</td>
<td>28235 4</td>
<td>14.81 high x 21.69 deep x 19.75 wide</td>
</tr>
<tr>
<td>Model 248E Weatherproof Carrying Case as shown in photo on page 1</td>
<td>14914</td>
<td>11 high x 21.25 deep x 22 wide</td>
</tr>
<tr>
<td>Model 248E 10 KW Amplifier Weatherproof Carrying Case as shown in photo on page 5</td>
<td>22457</td>
<td>16 high x 21.44 deep x 22 wide</td>
</tr>
</tbody>
</table>
MODEL 615
DIGITIZED 9.5 INCH
GRAPHIC RECORDER

- 40K bits of internal memory
- Alphanumeric printout
- 8 Scale lengths 50 - 10,000 feet, meters or ms.
- Thumbwheel selected delay
- Sound velocity adjustment
- Available in optional rack mount

Edo Western’s Model 615 Recorder is the ultimate general purpose graphic recorder. Its patented* digitizing process offers features not available in any other recorder, to provide broad flexibility under varying operational conditions. Its rugged construction and reliable operation measure up to Edo Western tradition.

*U.S. Patent No. 3,996,604
New
Generation
Recorder

Edo Western's new Model 615 Recorder combines a proven six us
drive mechanism with a unique patented digital processing system
to provide the ultimate general purpose recorder. This new generation
 recorder offers unmatched capa-
bilities in multiple scales data expan-
sion and recorder synchronization
plus a built-in alphanumeric
generator. The model 615 Recorder is
designed for applications where
precise, jitter-free operation is re-
duced and will meet the most
demanding marine, airborne or
laboratory requirements. The
materials and construction are iden-
tical to those Edo Western recorders
which have field proven their dura-
bility by years of trouble-free perfor-
mance in environmentally extreme
environments.

This new generation of graphic
recorders features a unique new me-
chanism and shows major data and features:

- Any segment of input data can
  be expanded to fifteen meters on
  the second 1 in. - 1200 sec. record.
- Operating at a 2:1 ratio reduces range of
data recorder.
- Direct correction for sound level.
- Direct selection of feet, meters, or
  millisecond
- Direct automatic record annotation

*U.S. Patent No. 4,066,494
null
Installation Data

Specifications

**Input**
- Signal level: 100 millivolts r.m.s. will produce full black printing. DC to 100 kHz
- Input impedance: 2500 ohms nominal
- EVENT mark: TTL low produces mark for the duration of the command
- External sync: Starts Delay-Write (data storage) sequence externally
- Transmit inhibit: TTL high inhibits transmit key pulse

**Outputs**
- Signal output: Raw sonar signal
- Key pulse: TTL level pulse (Note in the sparker mode the key pulses will be separated by at least 2 seconds)

**Display Modes**
- Input signal processing: Detected (Positive only)
- Data presentation: Left-to-right or right-to-left
- Delayed start: See display delay
- Scale length (displayed): 50, 100, 200, 500, 1000, 2000, 5000, 10,000 units (Units front panel selected ft., meters, millisecond)
- Display delay: 0-9990 units (ft., meters, millisecond)
- Resolution: 10 units

**Scale lines**
- 10 or 20 across chart

**Sound velocity correction**
- Feet: 4560-5040 ft second range
- Meters: 1425-1575 M second range

**Milliseconds**
- Corrections switches set to standard position

**Paper speed**
- 15, 100, 150, 200 lines inch

**Internal digitizer resolution**
- 2048 bytes samples per second
- Amplitude resolution 22 levels
- 1.5 bit binary bytes

**Display dynamic range**
- 26 dB white to black

**Power input**
- 115 V ±10V 50-65 Hz
- 200 watts max

**Environmental**
- Temperature: Operating — 10°C to 40°C
- Storage — 25°C to -65°C
- Humidity: 90%

**Shock & Vibration**
- To meet normal shipboard requirements

**Mechanical**
- Paper (electrosensitive): 9.5 (24 cm) wide 200 (60 m) long
- Size: See installation drawing
- Weight: 57 lbs max
MODEL 261C Digitrak®

DIGITAL SIGNAL TRACKER

The Model 261C Digitrak® is a compact and versatile digital output automatic signal tracking device capable of precision measurement and display of the underwater distance between two points. The Model 261C, which is a general-purpose unit that interfaces with any conventional depth sounder, is designed to aid the hydrographer or oceanographer in the recording and conversion to digital form of depth sounding or navigational position information for storage or computer processing. The versatility of the Digitrak® lends itself for such system uses as:

- Automatic Hydrographic Survey Systems
- Precision Transponder Navigation Systems
- "Flight” Control of Submersibles

The Model 261C Digitrak® is designed to operate on underwater sonar signals and is calibrated in feet based on an underwater sound velocity of 4800 feet per second. The time interval between a reference pulse and a time varying signal is measured by a precise digital counter. The distance information is available in digital form for transmission to a data storage device such as a punch tape or magnetic tape or for direct readout on a numeric printer. The information is also displayed in a numeric presentation for the operator’s convenience.

The Digitrak® eliminates the major problem in using digital timing techniques for echo ranging measurement (i.e., preventing reverberations, scattering, layer echoes, fish echoes, and other unwanted signals from triggering the counting system) by blanking these unwanted signals from the receiver by means of a tracking gate that “locks on” to the desired signal. This gate anticipates the signal position and permits only the desired signal to activate the time measuring circuits. The gate position varies automatically as determined by the echo tracking circuits.

The Digitrak® provides high reliability and minimum power consumption through use of solid-state and integrated circuit design. The modular design of the equipment permits modification or addition of circuitry for specific requirements and is priced to measure in feet, fathoms or meters at the standard price.

The operation of the Model 261C is completely automatic following initial adjustment of gate depth, gate width, detector sensitivity, and time constant. The gate depth is adjusted to the desired signal by observing the gate location on the front panel indicators and adjusting to the proper signal with the slew control. Proper tracking is indicated by simultaneous flashing of the Gate and Echo indicators and by the tracking light being lit. The detector setting is based on echo characteristics. If the signal is lost, the gate width is doubled.

The Model 261C Digitrak® is available with optional cabinet (as shown) or for 19” standard relay rack mounting. Cabinet and slides can be furnished for installation by the customer for conversion from rack mounting to cabinet closure.
MODEL 261C DIGITRAK™

OPERATION

The operation of the Digitrak™ can be seen from the block diagram, the precision bathymetric recorder (PBR) record, and the timing chart on the adjacent page. The PBR record illustrates the typical problem of measuring the time between transmission and receipt of the bottom echo in an acoustic underwater echo ranging system. The receiver output shown for the typical PBR record has outputs for the transmit pulse, reverberations, scattering layer echoes, bottom echoes, and the bottom returns. These signals are first processed in the Digitrak™ input circuits by an AGC threshold circuit that maintains a constant level relative to the average noise output of the receiver and a detector providing a constant amplitude output. The output of the detector circuit is shown in the timing chart.

The Model 261C Digitrak™ provides discrimination against unwanted return signals similar to those shown for the PBR record, by means of a gate circuit between the detector output and the counter control. The gate control signal and gate output are shown in the timing chart on the adjacent page. As can be seen from the timing chart, only the desired echo is permitted to pass the receive gate and be applied to the counter control circuits. The signal tracking portion of the system is used to control the position of the receive gate. The tracking circuits sense the position of each echo relative to the gate position and corrects the gate position if required to position the last echo exactly in the center of the gate. As can be seen, the tracking gate of the Digitrak™ permits continuous precise measurement of underwater distance in the presence of multiple echoes and high noise conditions.

OPERATION IN MULTIPLE-PING OR PROGRAMMED BATHYMETRIC SYSTEMS

The Digitrak™ is provided with a program controller that permits operation in multiple-ping or programmed bathymetric systems. For deep water sounding, many bathymetric systems use a "one-ping-per-second" type of operation or other programming resulting in more than one acoustic pulse in transit in the water at any specific time. This mode of operation provides maximum data rate for the recorder, but can cause difficulties when using a Digitrak™ in the bathymetric system. As an example, for a depth of 1300 fathoms and a 1.0 pps transmission, a transmitted pulse will be generated at depths corresponding to 0, 400, 800, and 1200 fathoms. The 1200-fathom transmission therefore precedes the bottom echo, and as the depth approaches 1200 fathoms, the Digitrak™ receive gate will permit the transmit pulse to pass and the tracker circuits will lock-on the transmit pulse. With the program controller, a transmit blanking gate is provided that prevents all transmission for a period of one second prior to the anticipated time of arrival of the bottom echo. This blanking eliminates the problem of the Digitrak™ from locking-on to multiple transmissions or reverberations or scattering layer returns from multiple transmissions.

RECORD INDICATION OF DIGITRAK™ DATA POINT

For bathymetric systems that include a precision bathymetric recorder as well as the Digitrak™, validity of the digital data can be continuously monitored by indicating on the graphic record the point at which the Digitrak™ sensed the bottom. To provide this capability, the Digitrak™ provides an output pulse that can be coupled to the recorder marking amplifier. To provide continuous monitoring of this reference point on all portions of the record, the pulse should be connected to a dark mark followed by a blanked area. This marking signal is automatically generated in the Edo Western Model 333 Precision Bathymetric Recorder (reference Data Sheet DR-4).
MODEL 261C DIGITRAK®

DIGITRAK® TIMING

BLOCK DIAGRAM
PERFORMANCE CHARACTERISTICS

Power Requirements: 115: 10 volts AC, 50-600 Hz, 45 watts
Range: 8000 feet, fathoms, or meters
Minimum Operating Range: 5 feet
Time Base Accuracy: ±0.1%
Input Signals: Count start circuit operated directly from a transmitter keying signal, detector
signal, internally generated signal, or other external signal. Requires two volt
pulse or zero on closure. Count stop circuit requires 50 mv rms signal, clamping
and gain adjust are provided. Detector key set-time constants of 1 and 5 ms
Detector sensitivity adjustable from 50 mv to 5 volts
Tracking Rate: Up to 60° continuous speed on the system or 15 knots, greater than 60° slope to
plant duration, or at reduced speeds
Gate Width: 10, 20, 40, 60, 80, 160, 320, 640, 1280, 2560 feet, fathoms, or meters
Gate Speed: 1 time gate width per pulse
Program Controller Outputs: Positive pulse which can be set from 25 to 500 milliseconds before start or gate
Digital Display: Delay Time – Updated each transmission
Display Resolution – 1 foot, fathom, or meter per second
Regulation – Five digits in line with rectangular to leading zeros
Tracking Alarm: Indicator – Audio and visual
Print Control: Alarm Control – Actuated by 1, 2, 4, or 8 seconds
Print command – 4 5 volts, 30 ma maximum output current. Adjustable from 200
to 275 ms duration. Other durations upon request
NOTE: Occurs after each transmission or following external read commands
External Read Command: Requires 3 5 to 14 5 VDC output. 320 single gate input 1 6 millisecond read.
Random: 2.999 feet, fathoms, or meters to 0.1 increment
Operating Temperature: 0°C to 50°C
Data Outputs: 4-line 1-7-4-8 BCD, 10 State, 4 5 volts, 12 State, 3 5 volts, 14 ma maximum
Output current
Construction: Electronic Circuitry – Solid state, with the majority of the system utilizing
Integrated Circuits
Design Guide: MIL-E-16400
Size: 5 1/2" high x 19 1/2" wide x 15 deep including connectors
Weight: 32 pounds for rack mount
Optional Equipment: 1) Optional available circuit cards provide the additional ability of tracking multiple
Echoes. This mode of operation requires a constant rate input timing signal whose
positive edge is always coincident with the transmitted keying signal. A timing
Card is also available which provides synchronizing so as to avoid interferences
from adjacent transducers.
2) First, last, or strongest signal selection – Front Panel Control
3) Tracking of multiple signals in multiple ping mode
Model 5810A
High resolution sound source

Description:
The O.R.E. Model 5810A, developed by Schenegg Research, incorporates two major advances in high resolution sound source technology. The Model 5810A generates a high acoustic source level of up to 220db* at 450 joules. This output level combined with a sharply defined wideband outgoing pulse, can penetrate deeply into sands and gravels with resolution unmatched by conventional profiling systems.

Of equal importance is the size and weight of the Model 5810A plate and catamaran assembly. Measuring 15 inches (38 cm) square and 1.25 inches (3 cm) thick, the plate is mounted on an ultralight PVC and stainless steel catamaran which is easily disassembled for transportation and storage. The entire unit weighs only 80 lb (36 kg) and can conveniently be launched, operated and recovered by one man without the need for special handling equipment. It is suited for operations from the smallest boats to large multi-sensor survey vessels and is compatible with most capacitor discharge power supplies currently available.

The Model 5810A has been exhaustively field tested in a variety of difficult sub-bottom environments with excellent results. This newest addition to the O.R.E. Seabed Survey line is available for sale or lease through O.R.E. offices worldwide.

* Ref 1 u pascal at one meter

Features:
- High Acoustic Output-220db Ref 1 u pascal @ 1 meter.
- Lightweight plate and catamaran for ease of handling and shipping.
- "Clean" wideband outgoing pulse for superior resolution.
- Successful operation even in sand and gravel.
- Compatible with existing power supplies and hydrophones.
- Field proven — the records speak for themselves.
Specifications

Model 5810A

Model 5813A Plate

Model 5812A Catamaran

Size: 52 in (132 cm) x 36 in (91.5 cm) x 20 in (50.8 cm)
Weight: 84 lb (38 KG) complete with Plate


General

Operating Speed: 5 knots

Towing Configuration: Surface tow with 2 towing steering lines

Ocean Research Equipment, Inc.

O.R.E. provides worldwide sales, service and leasing. Experienced field engineers are available for training, installation and operation of equipment. Call any O.R.E. office for the most cost effective solution for your requirements.

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Yeovil, Somerset
U.K.
Phone: 951.42000
Fax: 951.42001

O R E PLC Aberdeen
Aberdeen, Scotland
Phone: 214.519
Fax: N/A

Printed in the U.S.A. 6/82
The "All Purpose" Side Scan Transceiver

The unique O R E Model 160B Transceiver will handle the entire range of O R E Side Scan Systems and applications. High or low frequency, shallow water or full ocean depth, standard side scan or fully processed, every O R E Side Scan uses a 160B Transceiver.

Multiplied for Maximum Versatility

Multiplied all signals up and down the low cable eliminates the cross-talk and signal loss problems often encountered with conventional, non-multiplied systems. Multiplied also allows use of low-drag, low cost coaxial low cable. Other O R E systems such as sub-bottom profiling, acoustic navigation, depth measurement etc. can be added by simply "plugging-in" to the same cable.

Easy to Operate

Simplified basic controller/ setup allows the novice operator to obtain good quality data in any terrain. Yet sufficient adjustment flexibility is available to the veteran to fine tune as the situation requires.

Features

- Fully multiplied.
- Sends only 150 VDC on low cable, no high voltage breakdowns.
- 100 kHz or 30 kHz operation with throw of switch.
- Records obtainable at any control setting.
- All controls have off position for pure data.
- AGC, TVG, TVG Delay, Gain functions present.
- BNC connectors for all magnetic taping functions.
- Playback mode allows enhancement of taped data.
- Modular plug-in printed circuit cards used throughout.
- Compatible with all other O R E survey or positioning systems.
- Operates over any cable length.
- Allows use of low-drag, low cost coax cable or multi-conductor.
- Multiplying eliminates cross-talk between channels or systems.
**Description:**
The O.R.E. Model 159 Multi-Scan Side Scan Vehicle is one of the most versatile 100 kHz tow fish available.

Light enough in weight for convenient handling from small vessels. It has also set records for deep water operation. Because all signals are multiplexed, data quality and maximum operating range are maintained despite extreme cable lengths. While the use of small diameter coaxial cable allows increased operating depth and or towing speed.

**Features:**
- Operating depth—1500 meters.
- All signals multiplexed to eliminate signal loss and crosstalk.
- Modular construction for easy assembly and service.
- Shock-absorbing nose, and trip-release low-point pivot arm reduce chance of loss or damage.
- Uses low cost, low-drag coaxial cable.
- Also operates on existing multi-conductor cable.
- Adjustable internal ballast for shallow or deep operation.
- Interfaces with O.R.E. Sub-Bottom Profiling Systems.
- Optional tow vehicle navigation package available.

---

Impact-release shifts low point to free entangled fish. Lead ballast compartment for increased towing depth.

Modular construction for easy servicing.

Optional tow vehicle navigation package available.
THE 621 CAN STAND UP TO THE JOB

The 621 Directional Wave Recorder/Current Meter is our newest directional wave sensor. Designed with state of the art technology, the 621 DWCM measures pressure and 2-axis current data with every measurement, thus providing a diverse range of wave height and wave in data variants.

An outstanding feature of the 621 is its smart data storage approach in data processing. The 621 stores directional wave measurement data and selects, formats, and outputs data in text format in a new and efficient manner: the data before loading to text and then enhances the quality of the instrument. In addition, the data can be stored in main memory for processing and analysis. As a result of these features, the 621 is a powerful instrument for data processing.

More in this issue: Marine Met. The 621 DWCM can be used as a means of monitoring surface current data, which is a sensor with a high accuracy and quality sensor.

The 621 is a reliable instrument; it can be used as a current meter as well as a data tape wave recorder. The instrument has several settings to operate, including the slower speed suitable for measuring turbulence and measuring mean current speed. Moreover, at these slow measurement intervals, the 621 can take concurrent directional wave measurements, as can have 0.5 to 12

The 621 DWCM meters on the data collected on the response of the Marsh McBirney electromagnetic current sensor, the sensitivity of a Siemens pressure sensor, and on an 8-bit digital optical wheel compass for an accurate measure of near-surface currents. Continuous quarter second sampling and, in units of selectable vector averaging of the data are provided by the Sea Data SB 10 Sea Brain data cruncher. High density recording methods and a high capacity battery pack allow for deployments of over a year in length. Offering data recording in one of five selectable data formats, the 621 is ready to do many types of experiments.

Applications

- SURFACE WAVES
- SITE-SURVEYS
- BEACH EROSION STUDIES
- INLET SURVEY WORK
- TURBULENCE STUDIES

Highlights

- Switch-selectable burst wave recording rates down to 0.5 seconds
- Mature "Sea Brain" data cruncher with 32-bit arithmetic
- DIP switch selection of five operating modes, each with its own unique data format
- Switch-selectable burst data or simple mean data, both with averaging intervals from 0.5 to 4096 seconds
- Fully vector-averaged north and east mean data
- Seiche and internal wave measuring capability
- Marsh McBirney spherical electromagnetic current sensor
- Reliable Sea Data Model 610 recorder with 1S-meegabit capacity
- Inexpensive molded fiberglass alkaline battery pack
- A variety of additional sensors available using 6" card electronics
- Suitable for independent deployments of over a year in length
- RS-232C text interface
- Internal self-checking features
  1. Unstable mooring motion rate compass checking
  2. Zero offset subtraction for zero drift
  3. Calibration mode at the start of every burst
  4. Processor and CRC switches of ROM at powerup
- Easy-to-use operator's manual

Sea Data Corporation • One Bridge St. • Newton, MA 02158 • (617)244-3216 • TLX:951107 SEADATAMW
### 621 DWCM General Specifications

**Accuracy Switches:** 3-way: Water Velocity, Magnetic Direction, Depth and Temperature

#### Water Velocity
- **Sensor:** 3-way, 5-in. circular, 4-Disk, 1/2" sphere with low-voltage electronics
- **Range:** 0.15 to 120 knots (12-bit resolution)
- **Resolution:** 0.02 knots (1/4 of 0.15 knot)
- **Error:** Less than 0.5% (1 knot, typical, with 8 sec of slower running)

#### Direction
- **Sensor:** 20/50 digital optical, wheel encoder, with Sea Data Interface, 2000 rpm
- **Resolution:** 1.0°, 0.5°, or 0.1°, with typical wheel 30° with typical wheel current 420mA, 0 to 20mA, 0 to 40mA, or 0 to 200mA, 0.5° resolution + -45° from vertical

#### Temperature
- **Type:** 102.2° waterproof thermometer
- **Range:** -15°C to +5°C
- **Accuracy:** ±0.1°C
- **Resolution:** ±0.01°C

#### Data Storage
- **介质:** Standard digital certified 300 or 450 cassette tapes
- **Format:** Character Count
- **Description:**
  - SW: 82
  - R: 4
  - N: burst, average, pressure
  - M: 76
  - H: burst only
  - B: 50
  - A: average only
  - O: 0
  - C: custom thermistor, Scale Gauge

#### Timebase
- **Crystal:** 2.048152 MHz quartz crystal
- **Stability:** Stable to ±1 ppm over 1°C to 40°C
- **Accuracy:** Better than 30 seconds per 30 days

#### Burst Programming
- **Minimum Interval:** 0.1, 0.3, 0.5, 1, 1.5, 2, 3, 4, 5 minutes, and continuous
- **Minimum Interval:** 0.1, 0.3, 0.5, 1, 1.5, 2, 3, 4, 5 minutes, and continuous
- **Scan Rate:** 0.5, 1, 2, 4, 8 kHz
- **Typical Burst Cycle:** from 5 to 102 as determined by above switches

#### Power
- **Standard:** 288-V Sea Data Interface 350-watt alkaline battery pack
- **Optional:** 288-V Sea Data Interface 750-watt Lithium battery pack

#### Batteries of the 621-DWCM
- **Capacity:** 18 10-Ah (800)

#### Electronics Race
- **Size:** 30 inches long by 5.8 inches high

#### Data Retrieval
- **VEM:** The data written to the digital recorder may be retrieved directly by a VEM plugged into the serial data port. This is serial data with a resolution of 825 or 1920 (for multiple experiments. More than 5 minutes at less frequent intervals, etc.)

#### Lengths
- **0:** 0 to 19.5-foot (6 meters)
- **10:** 19.6 to 29.5-foot (6.0 to 9.0 meters)
- **20:** 29.6 to 39.5-foot (9.0 to 12.0 meters)

#### Pressure Case
- **Material:** 5051-H3 aluminium, 25 to 3000 psi
- **Finish:** Satin brushed aluminum exterior with aluminum paint

#### Mounting
- **Size:** 3.00" diameter by 0.50" long, overall 4.00" diameter by 0.50" long
- **Very small:** 0.75" 15 lb, 0.75" 25 lb, 0.75" 50 lb
- **Medium:** 1.00" diameter 750 stainless steel rod
- **Large:** 1.50" 1000 pounds

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**Contact:** Sea Data for more information on the 621 DWCM or any other Sea Data Product. Your area representative is [insert contact information].
635-12
SPECIFICATIONS

THE 635-12 DIRECTIONAL WAVE, TIDE AND CURRENT RECORDER

This specification sheet provides all relevant specifications concerning the Sea Data 635-12 Directional Wave and Tide Recorder. The 635-12 combines the proven capabilities of the Paroscientific Quartz Sensor, YSI Thermistor Temperature Sensor, Marsh Mc Birney Electromagnetic Flow Sensor, and the Sea Data 610 Recorder with 15-Megabit Tape Capacity in an extremely compact 11 inch pressure housing. This rugged and reliable instrument is designed for use in wave, current, water temperature, salinity, and wave buoy, and can measure conductance and wind velocity. The 635-12 is also available with the Marsh Mc Birney orbital velocity sensor head. The Model 610 Recorder used in the 635-12 is capable of recording 15 megabytes of data per 2.5 inch magnetic tape cassette. Data are read by the standard Model 120 reader, and a data processing system is available that vastly simplifies handling the massive amount of data that the 635-12 records.

- Uses the Paroscientific Quartz Sensor.
- YSI Thermistor Temperature Sensor.
- Marsh Mc Birney Electromagnetic Flow Sensor
- 0.05 cm Depth Resolution (20 m Range).
- 0.002°C Temperature Resolution
- 0.2 cm/sec Velocity Resolution.
- 0.4 cm/sec Orbital Velocity Resolution
- Uses the Sea Data Model 610 Recorder with 15-Megabit Tape Capacity
- Unique Data Compacting Schemes for Maximum Data Capacity
- Fully Reparable (Unpot-ted) Electronics

OTHER VERSIONS OF THE 635-12

In addition to the version of the 635-12 housed in a 11 inch pressure housing with an endcap-mounted sensor, the 635-12 is available with multiple transports and multiple sensors. Get in touch with us if you need a special configuration. In addition, the 635-12 is available in two alternate chassis styles:

1235-12

The 1235-12 uses the same electronics as the 635-12. It is housed in a 15 inch pressure housing with environmental/temperature housing; the pressure is provided by either a 12 VDC vehicle or 240 VAC. The recorder is capable of conducting wave and current data, and has a unique data compacting scheme for maximum recording capacity. The 1235-12 is powered with 120VAC, with an internal 48 VDC rechargeable battery keeepage, or by an external 12VDC source.

1735-12

The 1735-12 houses the 635-12's electronics in a 17 inch high package for mounting in a Mobile relay rack. Sensor cables are available in either 150 or double arm spread styles in lengths up to 1500 meters. The 1735-12 is powered with 120VAC, with an internal 48VDC rechargeable battery keeepage, or by an external 12VDC source.

The 1735-SCM Weather Station

An automatic station for the 635-12 is furnished as the 1735-SCM Weather Station, which features meteorological data and salinity, as well as all the parameters measured by the 635-12.

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The 635-12's front panel

ORDERING INFORMATION:
A Model 635-12 VDM Video Display Monitor is essential for testing and predeployment checkout of the 635-12. When ordering, specify the chassis size: 635, 12", or 24", and the face sensor range: 100, 200, 400, or 1,200 feet (622m). The 635-12 model sensor is the preferred sensor, due to limited overlapping of the sensor and decreased resolution due to attenuation at greater depths. This sensor provides adequate resolution and can be used at more locations than the 10 and 20 meter sensors. Additional sensors available for the 635-12 include conductive, turbidity and/or UDTM acoustic noise wind sensor. The 635-12 is also available with dual 400-foot transponders, 0.25s sec. scanning, event detection, multiple sensors and with an external test connector. Spare parts and repair hardware are available from Sea Data.

If you need more information concerning the 635-12 Directional Wave, Tide and Current Recorder, or about other Sea Data products, please get in touch with us!

SENSOR SPECIFICATIONS:

**Water Velocity:**
- Range: 0-100 knot
- Resolution: 0.01 knot
- Accuracy: ±0.5 knot
- Error: ±0.2 knot per knot

**Water Pressure:**
- Range: 0-10000 psi
- Resolution: 0.01 psi
- Accuracy: ±0.5 psi
- Error: ±0.2 psi per psi

**Acceleration:**
- Range: 0-50 g
- Resolution: 0.01 g
- Accuracy: ±0.5 g
- Error: ±0.2 g per g

**Temperature:**
- Range: 0-100°C
- Resolution: 0.1°C

**Electronics Specifications:**
- Memory: 360 x 400 characters per minute
- Power supply: 115 VAC, 60 Hz, 12 VDC

**Physical Specifications:**
- Weight: 45 lbs. (20 kg)
- Dimensions: 24" x 24" x 12" (610 x 610 x 305 mm)
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