OPERATING MANUAL

FOR

VENTURA HARBOR

EPISODIC WAVE MONITORING SYSTEM

PREPARED FOR

US ARMY ENGINEER DISTRICT LOS ANGELES

AND

VENTURA PORT DISTRICT

Version 1.3

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by

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Overview

The goal of this program is a data set of wave measurements at specific locations near Ventura Harbor during a high wave event– ideally, the peak wave conditions of the event. The plan is to deploy a small, instrumented buoy from a small boat at pre-selected site when high wave conditions are eminent. The buoy will measure the wave conditions during the storm and store the data internally. Simultaneously, the data will be transmitted to a receiver/computer that is located in the Ventura Harbor Patrol office. After the storm passes, the buoy will be recovered, and the data downloaded from the buoy and/or the receiver/computer.

The operating life of the buoys is approximately 10 days. **The decision of when (and if) to deploy the buoys is critical to success of the program, and it must be based upon the specific conditions of each event**. A fast-moving storm system that forms close to shore may not allow even one day before conditions become too dangerous for small boat operations. If the buoy is deployed too far in advance of a slow or erratically moving system may, peak conditions may not occur until after the buoy batteries are dead. Deployments far in advance of a storm carry an additional risk: the longer the buoys are on station – especially during moderate wave conditions- the higher the risk of collision, vandalism, or theft. Obviously, the same risk applies after the storm has passed.

The remainder of this manual is divided into six major sections:

Buoy Components

Buoy Checkout and Assembly

Base Station

Buoy Deployment

Buoy Recovery and Demobilization

Points of Contact

The digital version of this document is a Microsoft Word document named: **SPL Ops Manual.doc** and the date of this latest revision is 10 July 2003.

Buoy Components

There are five main components of the Mini Wave/Current Sentry System. These are: (1) the **hull,** with its **hull seal plug**, (2) the **battery pack**, (3) the **flotation assembly,** (4) the **anchor bridle** and (5) the **mooring assembly**. The first four components are identified by number in the buoy shipping container, below.

1) Hull

The **hull** is manufactured of PVC Tubing and contains the buoy instrumentation, data transceiver and GPS system in the upper compartment and the replaceable battery pack in the lower compartment. The longer antenna on the top (left side, above) of the buoy is the UHF telemetry antenna; the shorter antenna is the GPS receiver antenna. The lower compartment is sealed with a rubber compression seal by the **hull seal plug**. It may be removed by loosening the stainless steel nut on the bottom plate of the plug.

2) Battery Pack

The replaceable **battery packs** (one primary plus one spare) consist of nine (9) high capacity D-cell alkaline batteries and is carried in the battery compartment in the lower part of the hull. This compartment is accessed by removing the hull seal plug.

3) Flotation assembly

The **flotation assembly** consists of the flotation ring made of rugged foam material, two flotation support rings, and a locking collar with a stainless steel clamp.

4) Anchor Bridle

A **bridle** made of nylon strap fits over the hull, and under the floatation assembly. A ring at the lower end of the bridle is the attachment point for the anchor mooring.

5) Mooring Assembly

The **mooring assembly** consists of the buoy line, a sea anchor, the anchor line, anchor chain, and the anchor (see below).

Buoy Checkout and Assembly

Assembly consists of (I) installing a **battery pack**, (II) attaching the anchor bridle, and (III) fitting the **floatation assembly** onto the **hull**. The buoy case should include two fresh, unused battery packs.

I. Installing a **battery pack.**

A. Verify that the battery compartment does not contain a previously used **battery pack**, that the compartment is clean and dry, and that the battery cables are accessible.

1. Remove the **hull seal plug** by loosening the nut on the bottom plate and pulling the plug out of the **hull** (Fig. 1).

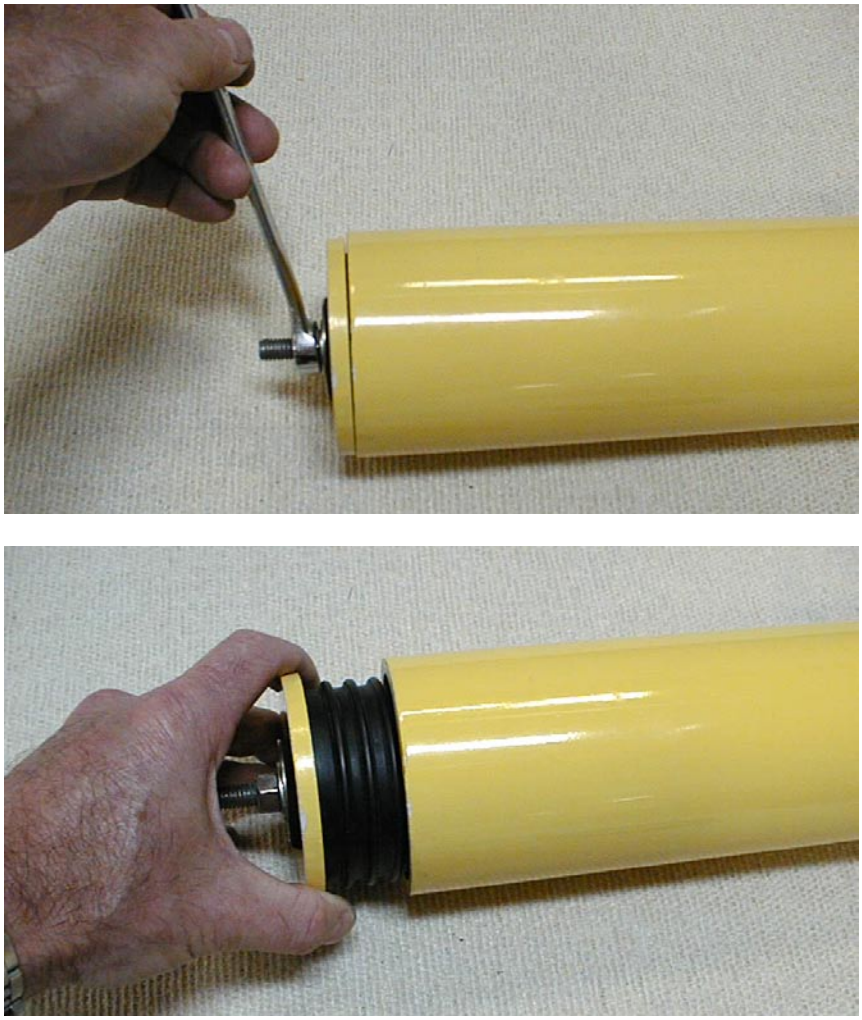


Figure 1 Removing hull seal plug

2. If there is a battery pack inside**, carefully** pull the battery pack from the hull compartment until the red and black power wires and connectors are accessible (Fig. 2).

3. Disconnect the insulated spade connectors on the red and black power wires and remove the battery (Fig. 2).

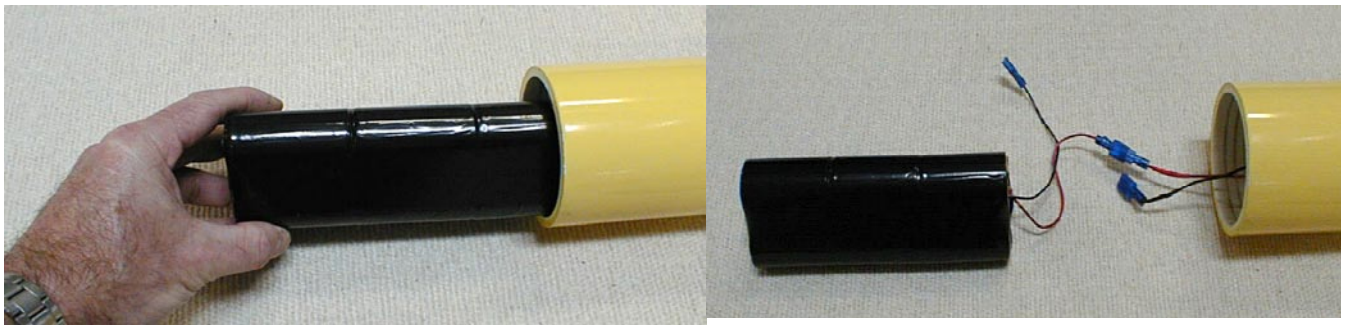


Figure 2 Removing battery pack (l) and disconnecting power wires (r)

B. Check the voltage of the available battery packs.

Note: Each available battery pack, even if assumed new and unused, should be checked to assure it has acceptable power before installation.

The no-load voltage of a new **battery pack** should read **14.4** volts. A voltage of **11.3** volts or less indicates a battery with less than **half** of its rated power, and should not be used. A decision to use a battery with a voltage of between 11.3 and 14.4 volts should be based upon the logistics and risks of obtaining a fresh **battery pack** in time for deployment versus the risk of the buoy running out of power prematurely. In any case, always use the **battery pack** with the highest voltage.

C. Install the battery pack into the battery compartment

1. Connect the two wires on the new battery pack to the two buoy power wires (battery red wire to buoy red wire and battery black wire to buoy black wire) using the insulated spade connectors.

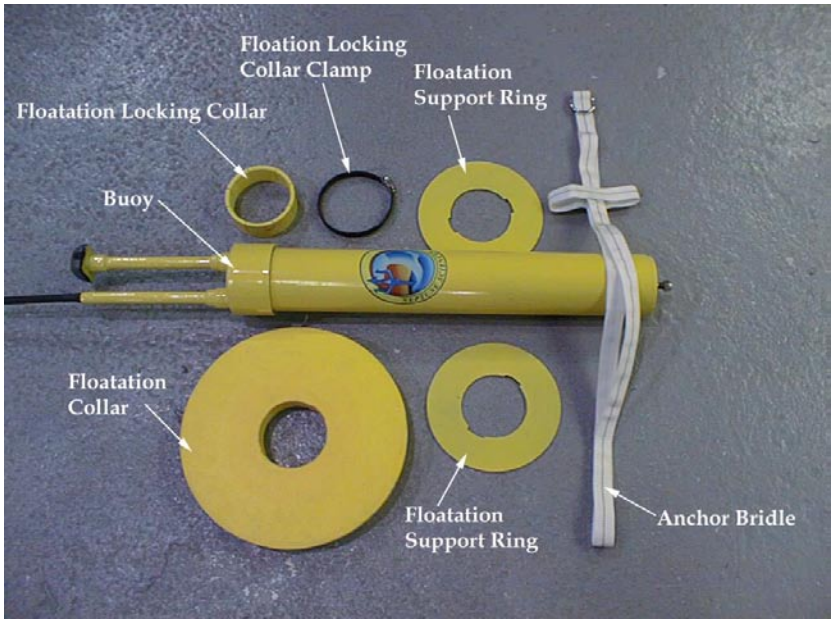
2. **Carefully** place the new battery pack completely up into the battery compartment.

3. Inspect and clean the hull seal plug, push it all the way into the hull, and tighten the nut on the bottom plate to seal the hull.

D. Replacement battery packs can be obtained from the buoy manufacturer, Neptune Sciences, Inc. (See "Points of Contact" at the end of this manual.)

II. Attaching the **anchor bridle** and the **floatation assembly** onto the **hull**

A. Read the instruction and study figures before installing anchor bridle.



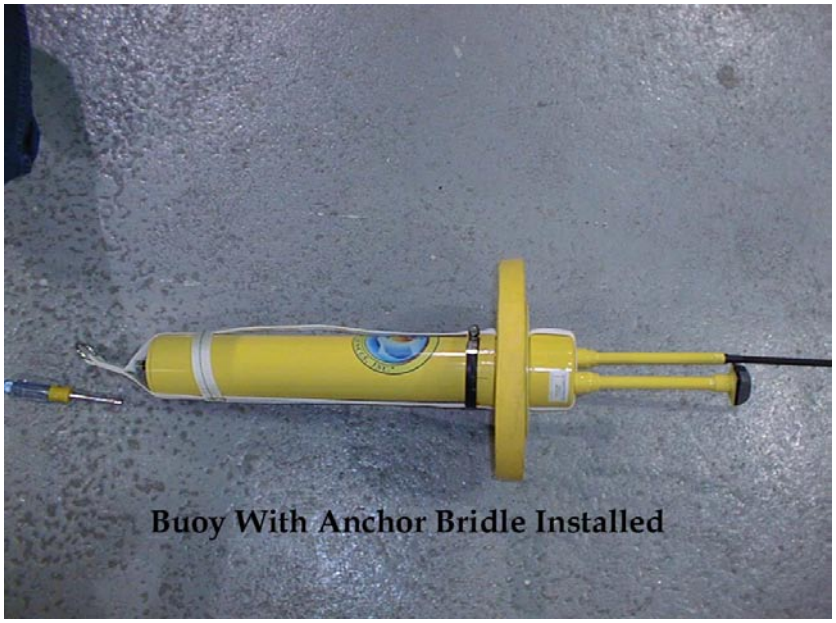


Figure 3 Anchor bridle and floatation assembly components (top) and installed on hull (bottom)

B. Remove buoy, floatation parts and anchor bridle from shipping case.(Fig. 3, top)

C. Slide the bridle strap through one of the floatation support rings. Ensure straps are not twisted. (Fig. 4)

Figure 4

D. Slide bridle straps and floatation support ring onto the bottom of the buoy. Ensure the straps are not twisted and the straps are positioned in the slots cut into the floatation support ring. (Fig. 5)

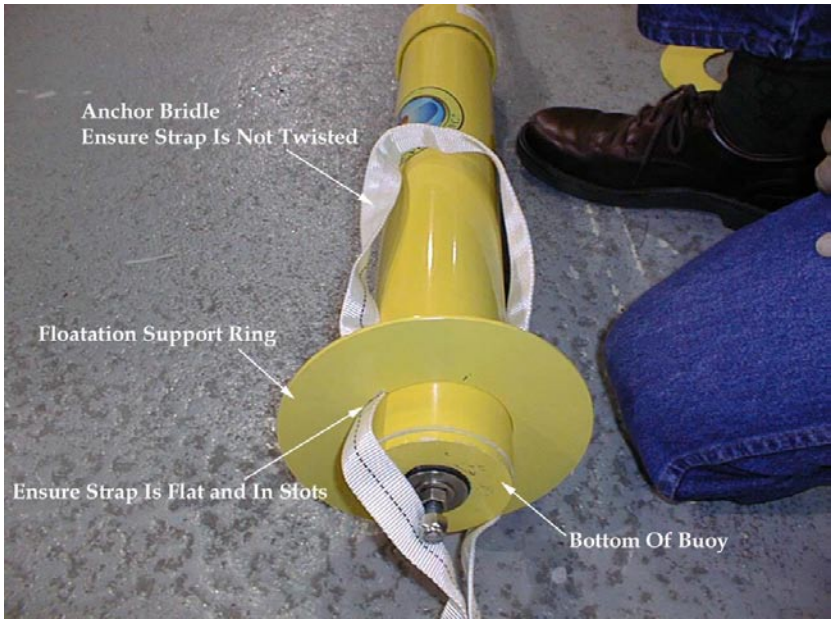


Figure 5

E. Slide floatation over straps and onto buoy bottom. Ensure straps are not twisted (Fig. 6) and that the printed "Government Property" decal faces upward (Fig. 7)

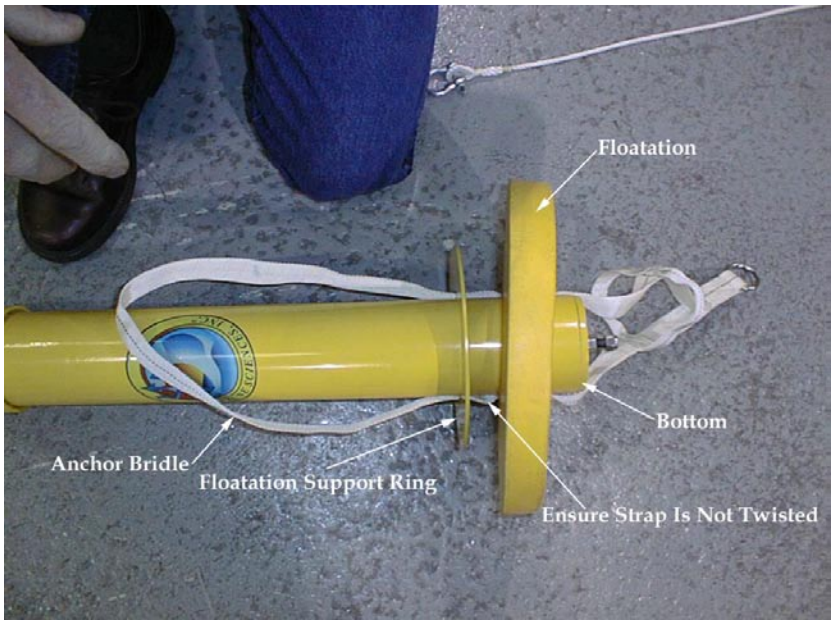


Figure 6

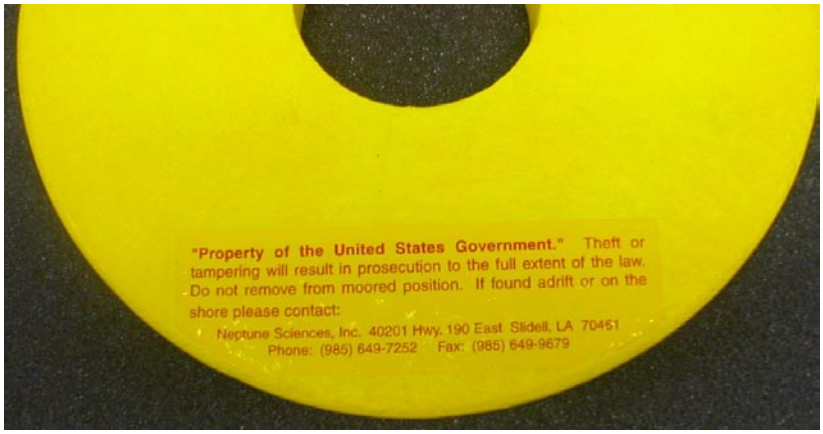


Figure 7

F. Install bottom floatation support ring over straps and onto the bottom of the buoy. Ensure that the straps are not twisted. (Fig. 8)

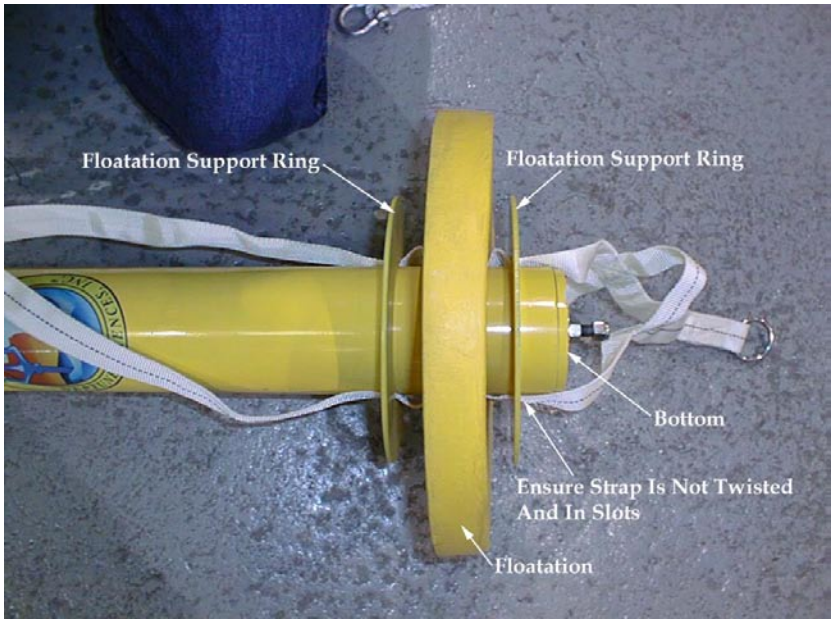


Figure 8

G. Slide the floatation locking collar on to the bottom of buoy with the slots on the collar facing toward the bottom of the buoy. Ensure the straps pass over the collar. (Fig. 9)

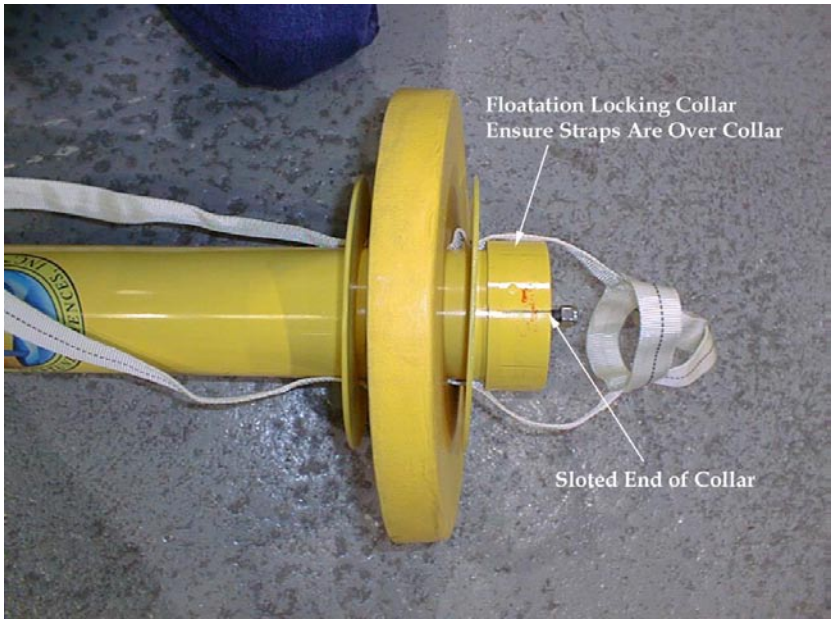


Figure 9

H. Position the bridle band on to the bottom of the buoy. (Fig. 10)

Figure 10

I. Slide all the floatation parts and bridle towards the top of the buoy. Pass the strap between the antenna masts. Ensure the straps are not twisted. (Fig. 11)

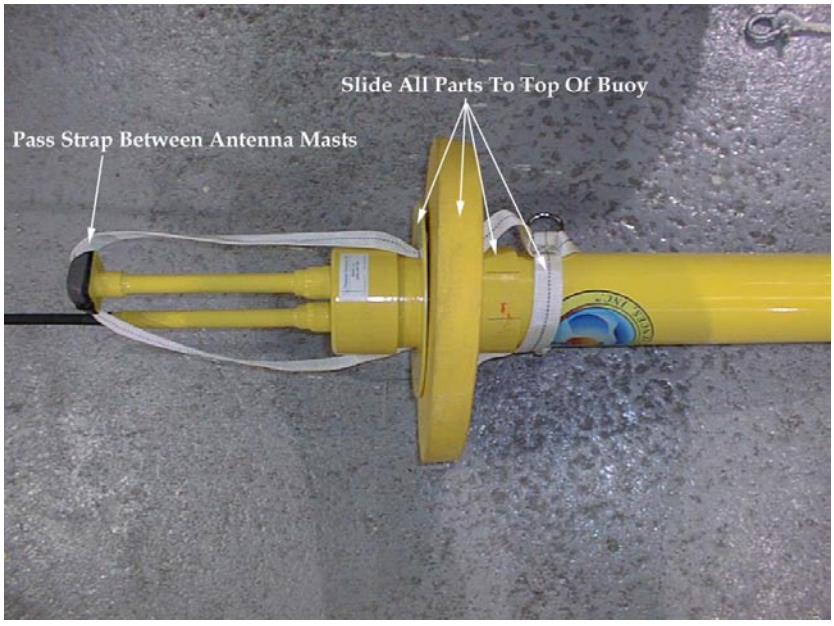


Figure 11

J. Slide all the floatation parts towards the bottom of the buoy including the bridle. Ensure the strap is lying flat and between the antennas. (Fig.12)

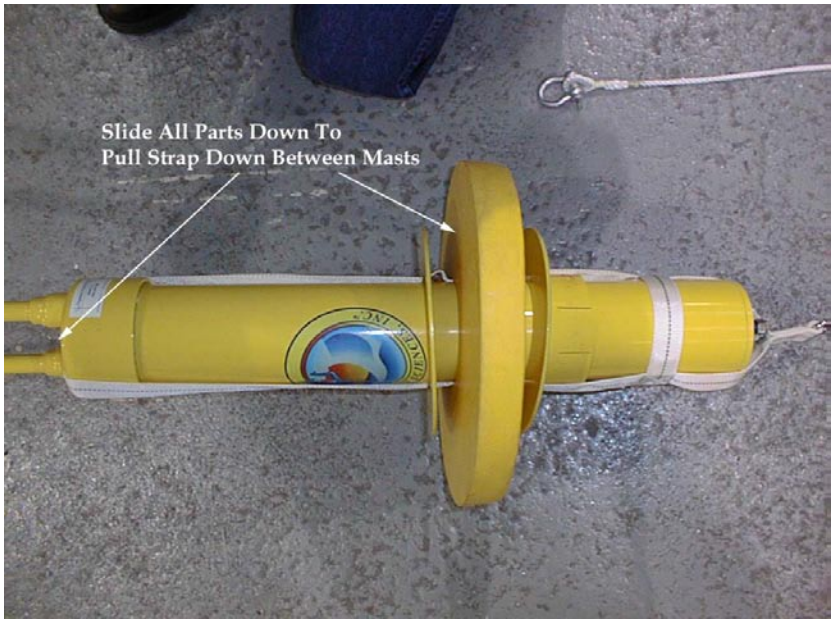


Figure 12

K. Position the upper floatation support collar against the top of the buoy. Ensure the straps are straight (Fig.13)

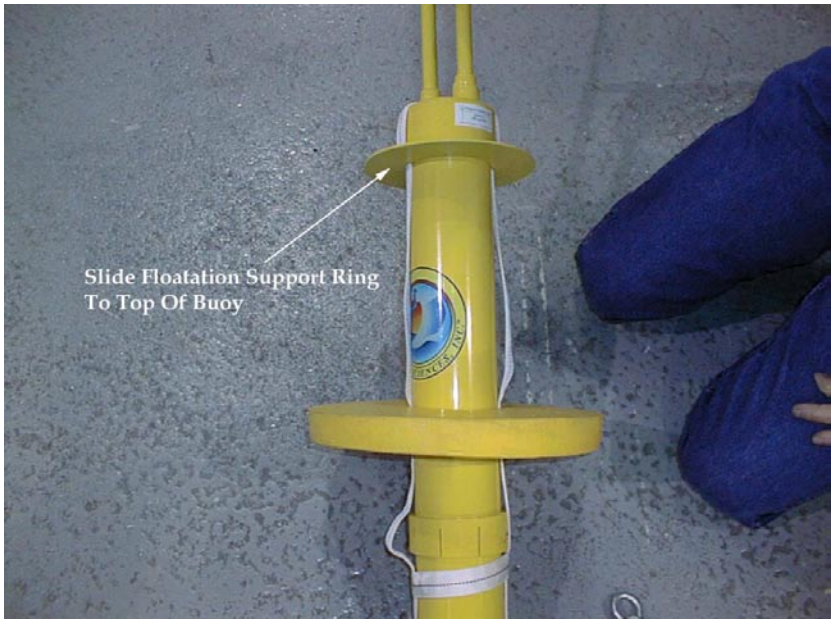


Figure 13

L. Slide the floatation to the top of the buoy, again ensure the straps are tight. (Fig.14)

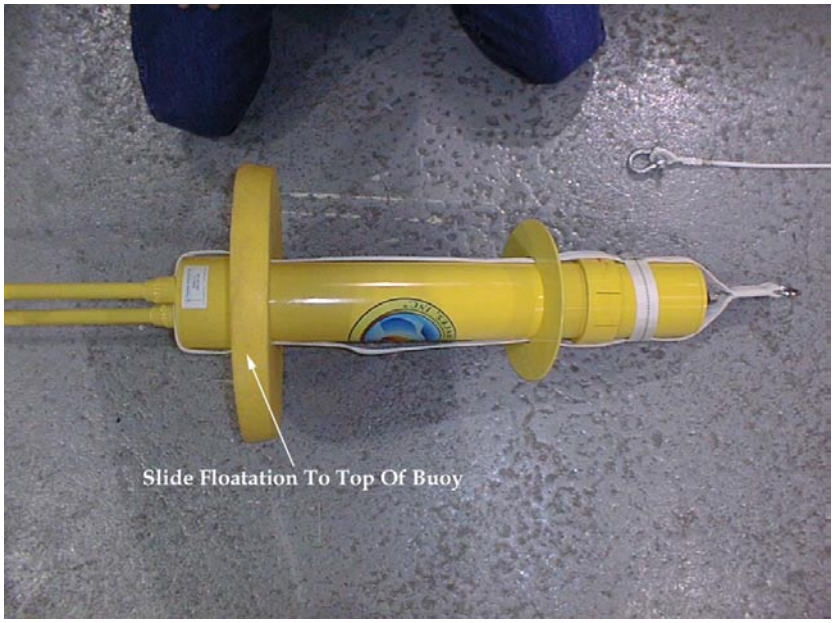


Figure 14

M. The lower floatation support ring is positioned to the top of the buoy. (Fig.15)

Figure 15

N. Slide the floatation locking ring against the lower support ring. (Fig. 16)

Figure 16

O. Install floatation locking collar clamp over the straps and the locking collar. (Fig. 17)

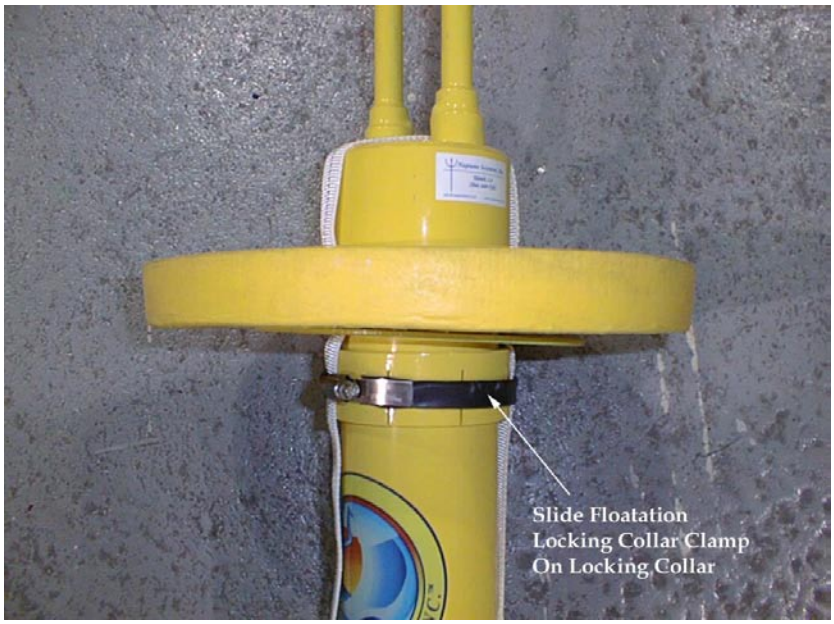


Figure 17

P. Adjust the bridle straps so that they are even length on both sides of the buoy. The bridle band should be parallel to the bottom edge of the buoy. Press all the floatation parts tight against the top of the buoy while ensuring the straps are tight. Align the clamp with the bottom of the locking collar and tighten the clamp. (Fig. 18). Refer back to Fig. 3 (bottom) to assure proper assembly.

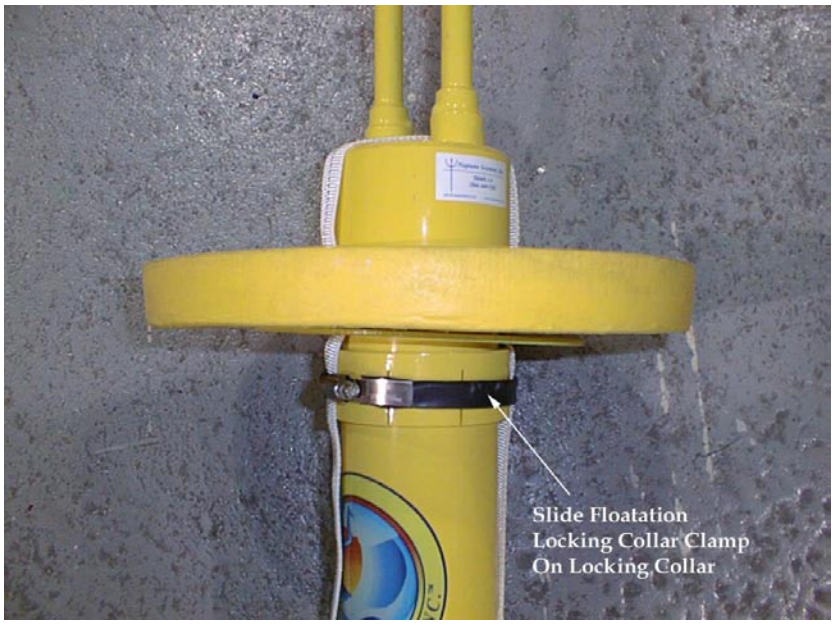


Figure 18

III. Attaching the Mooring Assembly

The **mooring assembly** consists of the buoy line, a sea anchor, the anchor line, the anchor chain, and the anchor (Fig. 19).

Figure 19

A. Install shackle provided between the buoy line and the anchor bridle. Mouse the shackle; i.e., prevent the shackle pin from turning with a length of line, stainless steel wire or a nylon wire tie. (Fig. 20)

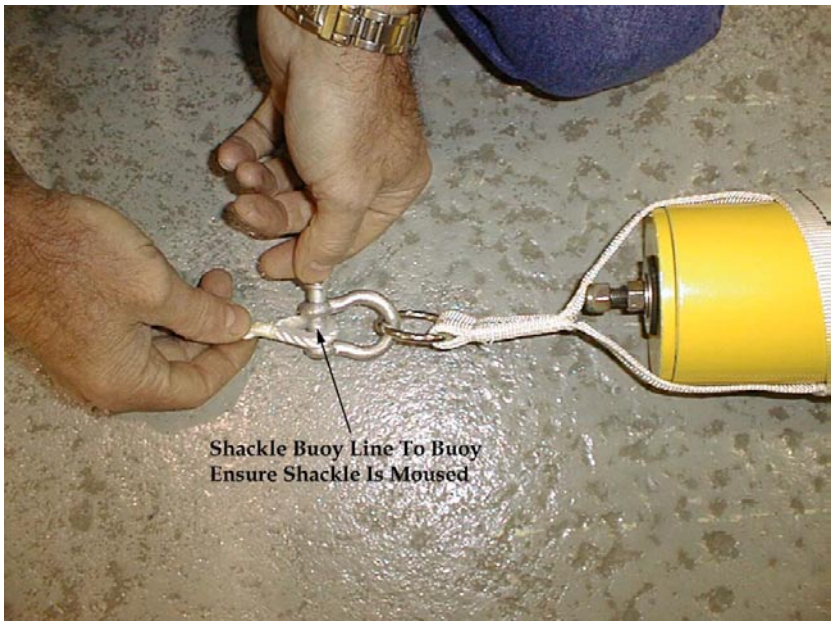


Figure 20

B. Install the shackle provided between the sea anchor bottom and the anchor line. Mouse the shackle. (Fig. 21)

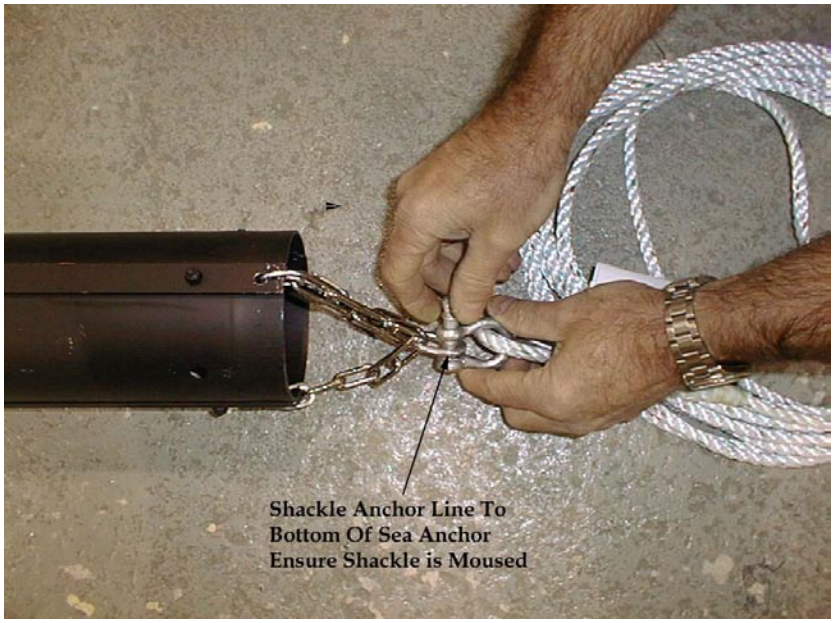


Figure 21

C. The assembled system, ready for deployment.

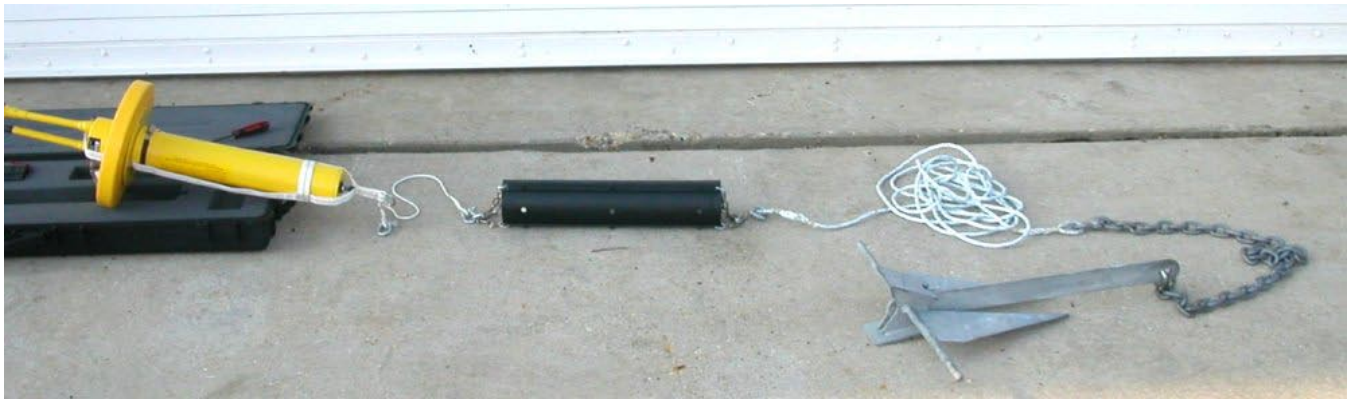


Figure 22 Buoy attached to mooring, ready for deployment

IV. Turning the Buoy On - **To prepare your buoy for deployment:**

1. Bring up the receiving software on the base station computer (refer to the next section).

2. Just before deployment, remove the Stainless Steel plug (Fig. 23) at the top of the buoy and push the button underneath once, using a blunt pen or pencil. If using the RF detector (Fig. 24), hold the detector antenna parallel to buoy antenna and a single tone should be heard after 5-10 seconds followed by a chirp after about 3 seconds. The base station should also receive data verifying that the buoy is on. This activates the buoy. Reinstall stainless steel plug.

Note: Periodically, lightly lubricate O-ring with silicone grease

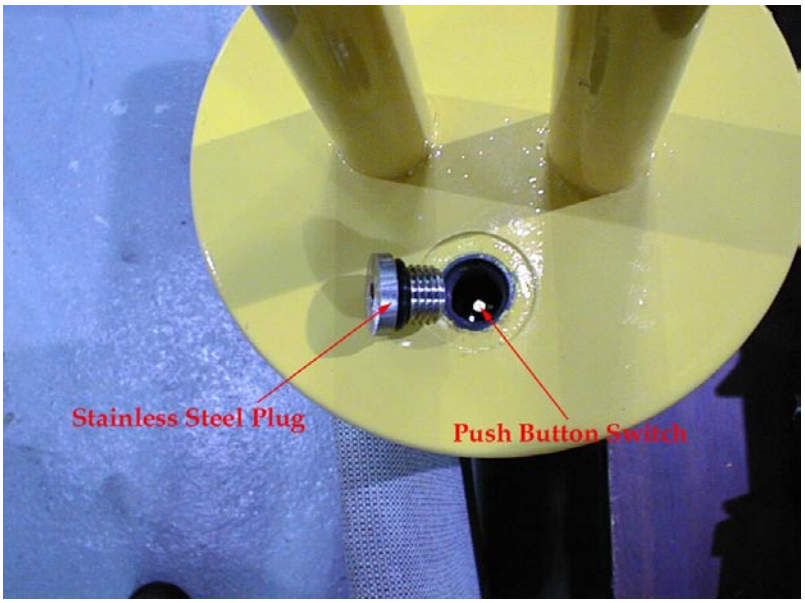


Figure 23

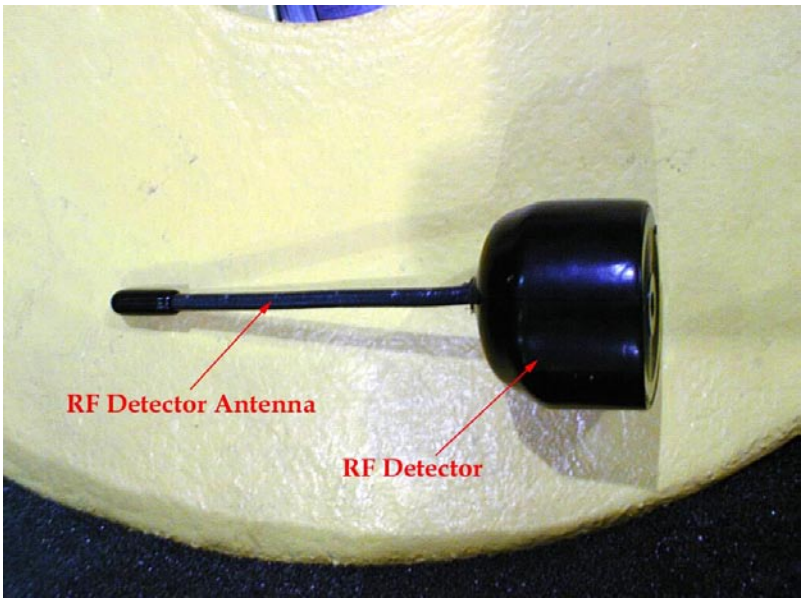


Figure 24

Be sure to install stainless steel plug after turning on buoy to ensure watertight integrity!

If you followed the above steps carefully, you are already collecting and archiving wave data and GPS position onboard the buoy. The next section will show you how to initialize the base station and receive data from the buoy. The Mini Wave/Current Sentry has a default configuration setup that is applied each time the buoy is activated. On initial power up the buoy will begin collecting wave data and GPS position/time. After the data are collected and analyzed within the buoy, the buoy will send a message showing the wave conditions and GPS information acquired. Messages are sent approximately every ten minutes. A start up message is sent every time the buoy is activated prior to deployment. All messages received by the base station are automatically logged.

Base Station

I. Description

The Mini Wave/Current Sentry communicates to the base station using a UHF Spread Spectrum radio modem and antenna. The Mini Wave/Current Sentry radio modem is a spread spectrum device that operates in the 902-928 MHz frequency range. This type of RF device does not require a US FCC license to operate. The modem's output is approximately 1 Watt on transmission and the effective range is line of sight, which is dependent on antenna height. The base station antenna (Fig, 25) is permanently mounted on the roof of the Ventura Harbor Patrol Building (Fig. 26), giving an effective range of communication of about 10 km.

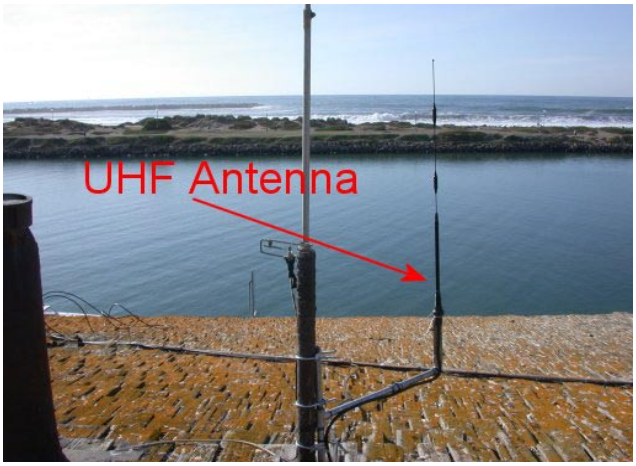


Figure 25

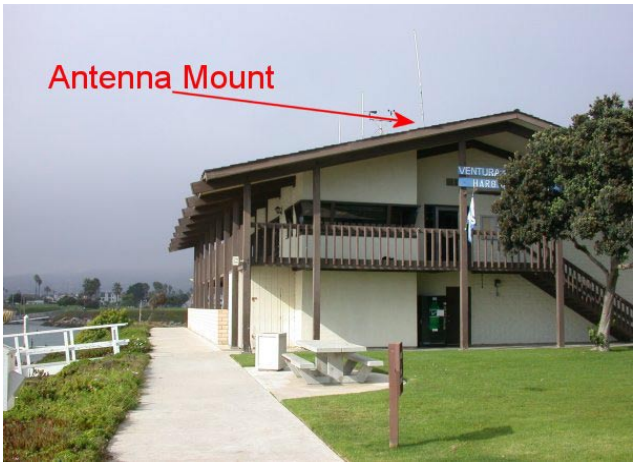


Figure 26

The base station radio modem and computer (Fig. 27) are located in the main office on the 2nd floor of the building. The modem and excess coaxial cable are at the base of the cable conduit behind a partial wall on the western side of the building; its power supply is under the adjacent desk. The dedicated base station computer is a Dell Pentium 4, also located under the adjacent desk. A switch on the desk allows the user to select operation of either the base station computer or the standard office computer using one mouse, keyboard, and monitor.

Figure 27 Base station modem (l), computer (c), and switch (r).

II. Installing the Base Station Software

In the event that the base station computer is replaced, the base station software will have to be reinstalled on the new computer. The base station software is included on several floppy disks or a single CD-ROM included in the packing case. Before installing the base station software, make sure that the computer you will use as the base station has a free serial RS-232 COM port for the modem connection. In addition, the base station computer operating system should be Microsoft Windows based.

To install the software:

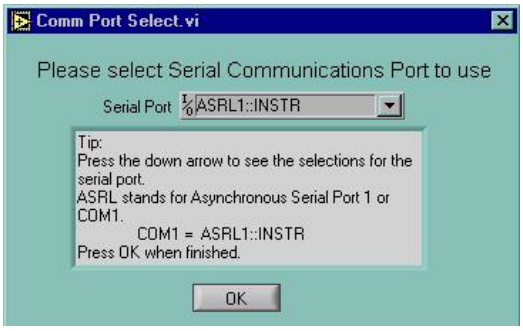
1. Insert the CD-ROM or the floppy disk labeled "Disk 1"
2. If the installation program does not begin automatically, run "Setup.exe" from windows explorer.
3. Follow the on-screen directions to complete the installation.
4. You must also install the Mi-Visa Software. To do this, change directory in the CD to Ni-Visa and run nivisa25runtime.exe. Follow the on screen directions to complete installation,
5. A program will be created under your Start Menu containing the Mini Sentry software. You will be able to receive data from the buoy once you have connected the 9-pin communication cable to the serial COM port of your base station computer and to the DB-9 COM port on the radio modem.
6. If you followed the above procedures and the base station communications software does not start, contact the buoy manufacturer.

III. Operating the Base Station Software

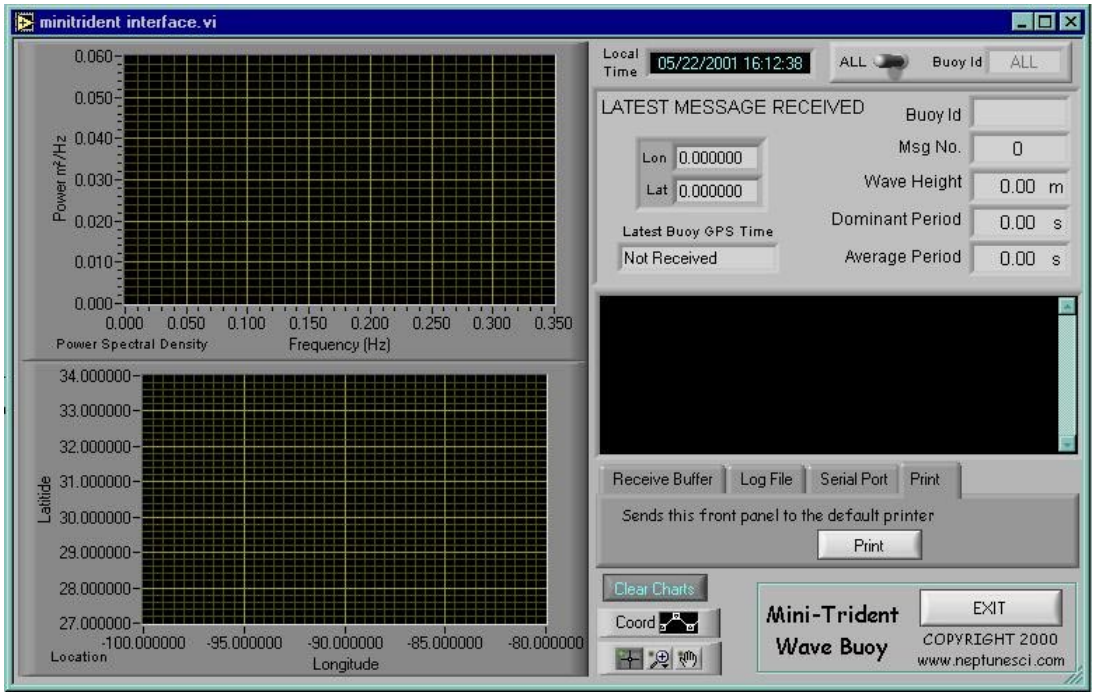
The base station display software is a simple graphical interface that allows the user to track and plot location of one or more buoys, display received GPS data, and display wave data. The user can modify the on-screen controls to customize for a specific deployment.

To begin operating the Base Station Software:

1. Run the Mini Wave/Current Sentry program from the windows menu. The COM port selection window, shown below, will appear on the screen. Choose the appropriate Serial Communications Port from the pull-down menu and select "OK".



The next screen that opens is the control and data display page. This software window is optimized for a screen resolution of 800 by 600 pixels, but operation is not affected if the computer is set to a different resolution.



2. You can select display and graph results from "ALL" the buoys active or just display a specific buoy by flipping the Buoy Selection switch. Note: All messages received from all active Mini Sentry buoys are stored to the log file regardless of this setting. This switch only affects which buoys are displayed.

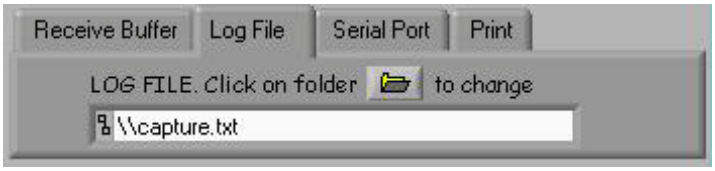
3. You are now ready to start receiving data from your Mini Wave/Current Sentry.

Buoy Control Options:

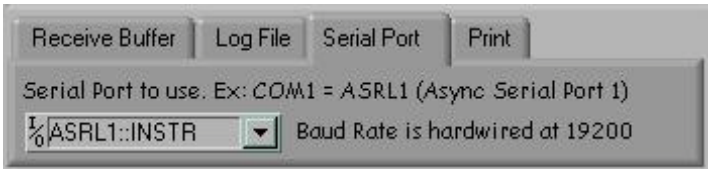
The buoy controls are located on a folder on the right-hand side of the user display window. To activate one of the control functions, select the tab for the appropriate control option.

Print: Use this control to print a snapshot of the display.

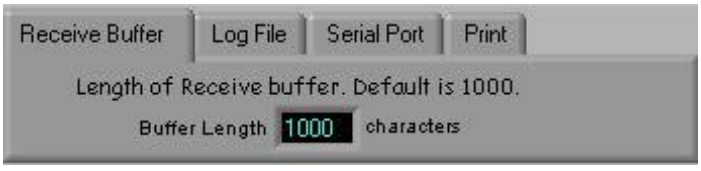
Log File: This control is used to select where the program will store the log file for the current session. Press the folder icon to select a different log file, otherwise, data will be appended to a file named capture.txt on the root directory. The format for this file is ASCII text.



Serial Port: This control is used to select a serial port to use to communicate to the radio transceiver. You will not need to modify this control unless you changed ports since you started this session.

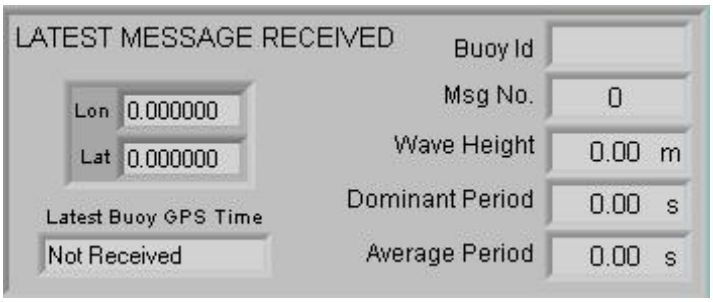


Receive Buffer: This control is used to set the size of the buffer for the incoming serial port data. The default value of 1000 is appropriate for most applications. If you are having problems receiving data, contact the manufacturer before changing this setting.

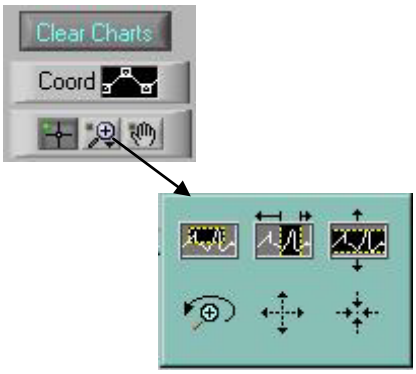


Data Displays:

Data acquired and processed is automatically sent to the base station. The data are displayed in the **LATEST MESSAGE RECEIVED** window as well as in the tracking and power spectral density charts.



Location and Power Spectral Density Charts: These charts are a visual representation of the acquired data. The power spectral density is a wave energy spectrum that provides the wave energy spectral density (units are m^2/Hz) as a function of wave frequency. See Chapter 4 for additional information about the wave height and period parameters as well as wave energy spectra. The location chart is a tracking of a particular buoy. It is updated when newly acquired data are available. You can control zoom and panning with the controls below.



Local Time: This display shows the computer's current time. Data stored to a log file is time tagged with this time.

I. General

Three locations have been pre-selected for buoy deployment (Table 1 and Fig. 28). The primary site (A) is in 40 ft of water, approximately 0.4 n mile W of the northern end of the breakwater. An alternate site (B), 0.4 n miles NNW of the northern end of the breakwater, will experience less reflected wave energy during events with a strong southerly component. A third site (C) is located in the center of the entrance channel, about halfway between the harbor entrance and sea buoy. Site C experiences the most dangerous conditions when navigating the entrance channel, according to Scott Miller. Deployments at this site would have to be during daylight hours only and under conditions when minimal traffic was expected in the entrance channel. The decision of which site to use for a deployment should be made in coordination with CESPL.

Site	Latitude	Longitude
A	34° 15.040' N	119° 16.890' W
B	34° 15.389' N	119° 16.635' W
C	34° 14.556' N	119° 16.566' W

Table1. Deployment Site Positions

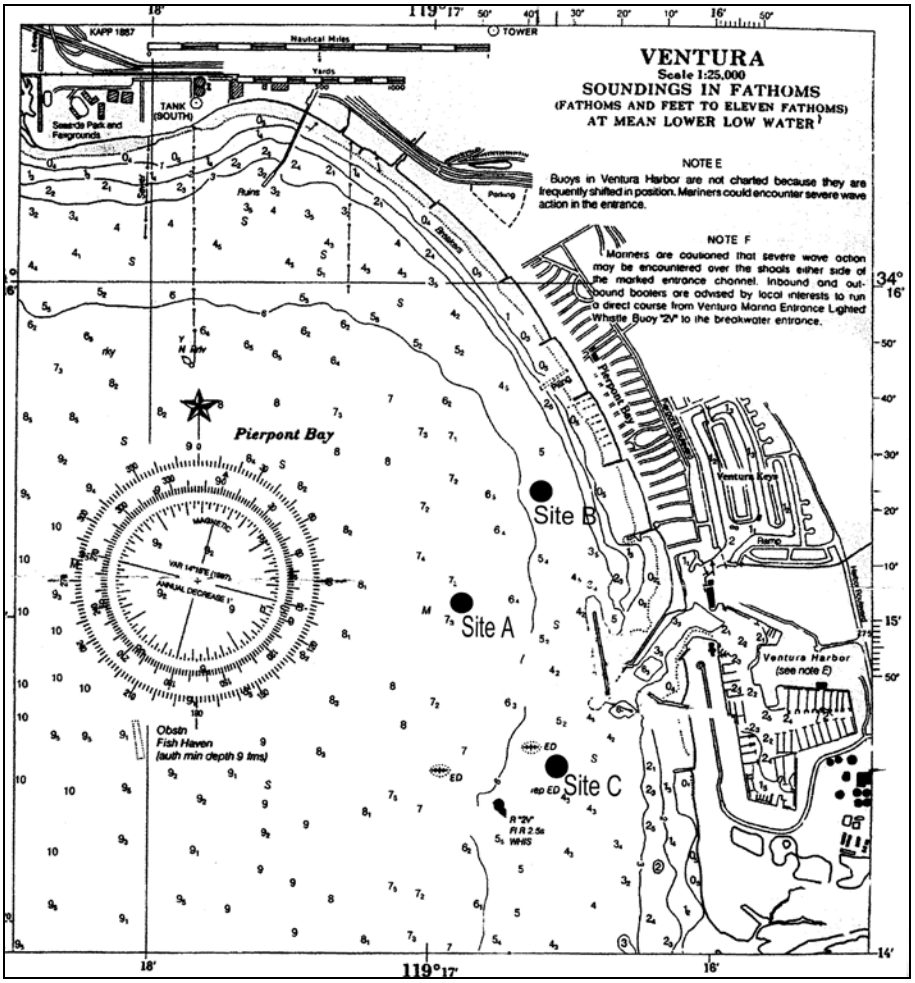


Figure 28 Locations of Pre-selected Deployment Sites

These sites can be reoccupied quite accurately using a GPS receiver or by use of visual ranges onshore, as will be described below. However, it is neither necessary nor desirable to spend an inordinate amount of time attempting to deploy the buoys exactly at these locations. Deployment of the buoys within 100 to 200 m of the pre-selected sites is satisfactory. **Because the buoys contain an internal GPS receiver, the location of each measurement will be available in the measured data.** The important deployment criteria is that the site is no more than 1.5 miles in a direct line of sight of the radio antenna at the Port District building, and that it is not significantly affected by reflected waves coming from the breakwater.

The buoys are deployed from a small craft, assumedly the harbor Patrol . A crew of 2 (boat operator and deckhand) is sufficient; a second deck hand will make deployment easier, especially under rough conditions. Under calm conditions, the buoys could be deployed by a lone, skilled boat operator, but this is not advised. Two sources of a small craft are described below.

II. Getting On Station

Photographs of the visual ranges for each site are provided at the end of this manual (Plates A-C). Simply lining up the two range marks, as in the photos, assures that the vessel is on one of the range lines. When both ranges are aligned, the vessel is very near the pre-selected site

The visual ranges are useful for quickly locating the sites without need to plot positions on a chart or steer using latitude and longitude. Generally, it is best to line the vessel up on the eastern range somewhat offshore of the site, and steer the vessel shoreward while keeping the ranges in line. As the southeastern range begins to come into view, the vessel is slowed and allowed to drift onto the site where both ranges are aligned.

III. Deployment

Deploying and recovering a buoy from a small vessel is trivial when there are no waves or current, and nearly impossible when conditions exceed safe operating limits. The seamanship skills and judgment of the deployment crew should take precedence over any prescribed procedures. The following method should prove effective in most cases. Its focus is on avoiding damage to the buoy and mooring, at the expense of speed. For example, deploying the anchor first and letting the anchor pull the mooring, then the buoy, overboard is faster, but entails the risk of damage if the mooring or buoy hangs up on any part of the vessel. On site conditions, crew makeup, or vessel characteristics may dictate alternatives to either of these two options.

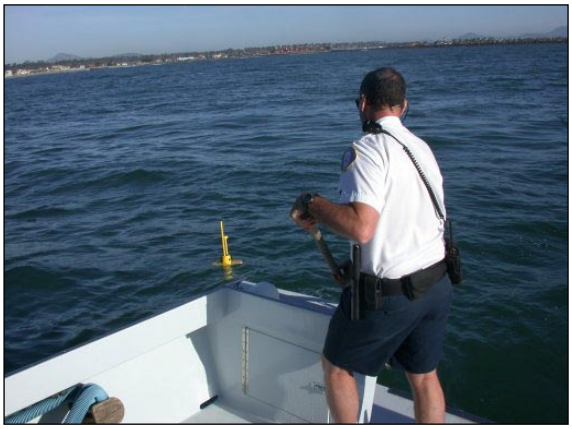
The mooring line should be faked (i.e., dropped into) an open container – a milk crate works well – beginning with the anchor end, to allow it pay out without hanging up. The anchor itself is left outside the crate. In most cases, it will be desirable to head the vessel into the prevailing wind and maintain just sufficient speed to allow steerage. The buoy and sea anchor should be placed over the side of the vessel and trailed behind the boat as the mooring is paid out (Fig. 29). The anchor is lowered over last. The vessel should maintain course and speed until well clear of the buoy. Obviously, a principal concern is to avoid entangling the mooring with the vessel's wheel. This is the most likely problem to be encountered during deployment, especially if strong winds and steep seas have already developed. This risk is compounded greatly by any attempt to recover and re-deploy the buoy. That is one reason why successfully deploying a buoy even several hundred m from the pre-selected site is preferable to repeated attempts to achieve unnecessary precision in placement.

Figure 29 During deployment, pay out the buoy and sea anchor first, then the mooring

Buoy Recovery and Demobilization

I. Recovery

Recovery requires more skill and care from the boat operator and crew than deployment. It is challenging to precisely position a boat with even a light wind blowing, and the helmsman's view of the buoy will likely be blocked by the hull as he approaches it. While the buoy can withstand considerable impacts from the boat hull, it would be damaged if struck by a moving propeller. Also, entangling the mooring line in the propeller, rudder or outdrive is a constant concern.



Approach the buoy from downwind, at just sufficient speed to maintain steerage. The helmsman should pass alongside the buoy at a distance of several feet - as opposed to aiming directly at it. A deckhand can use a boat hook to snag the mooring line just under the buoy as it passes alongside (Fig. 30). As soon as the buoy is snagged, the helmsman should put the engine(s) in neutral. The deckhand can then bring the buoy aboard and pull in the mooring, maintaining tension on the mooring line at all times (Fig. 31).

Figure 30

Figure 31 Maintain tension on the mooring line during recovery (l) until the anchor is aboard (r).

II. Cleanup and Storage

All components of the system should be rinsed thoroughly with fresh water and allowed to air dry. The buoy is best disassembled for long term storage; reverse the procedures followed in "Buoy Checkout and Assembly."

Remove the used battery pack and safely dispose of it. It is not recommended to keep used batteries unless availability of a new one before the next deployment is questionable. If a used battery pack is kept as a backup, clearly label it as "used." Measure and record the voltage of the used battery pack, and include this in the label, along with the date and number of days/hours of operation it received. New battery packs should be procured from the manufacturer at the end of each deployment to replace those used. New packs should be clearly labeled as "new" and include the measured voltage and the date of purchase. The shelf life of a new battery pack is 5 years. The remaining shelf life of a partially used battery may be reduced from the original projection.

Points of Contact

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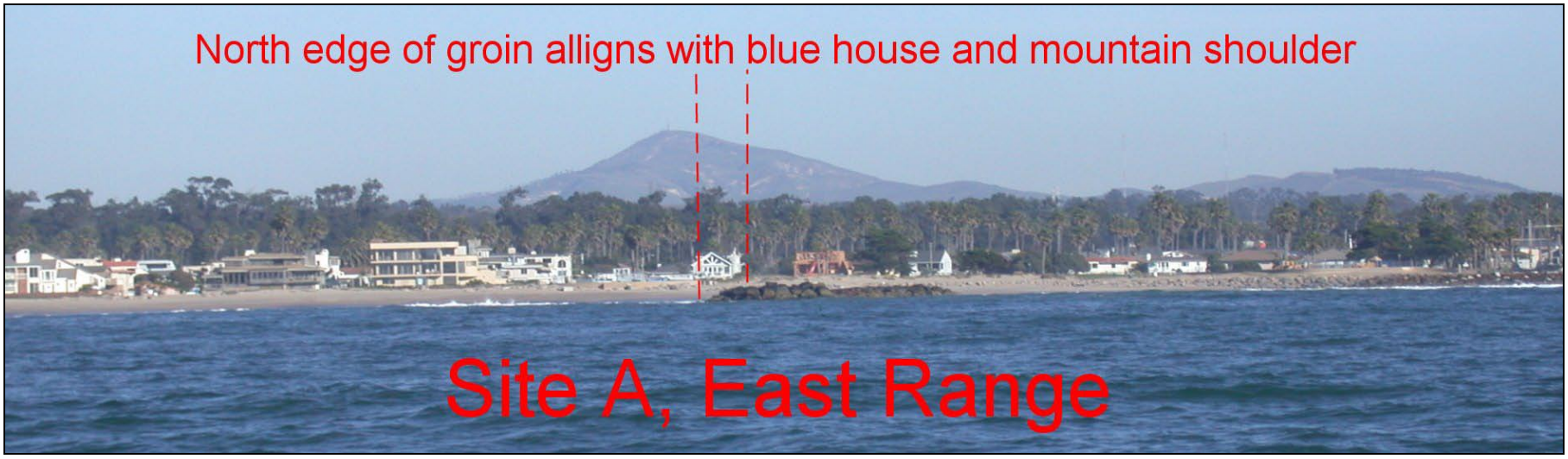
Buoy Manufacturer -	Neptune Sciences, Inc. 40201 Highway 190 East, Slidell, LA 70461 Office: (985) 649-7252 Fax: (985) 649-9679 info@neptunesci.com

NOTES


North edge of groin alligns with blue house and mountain shoulder
Site A, East Range

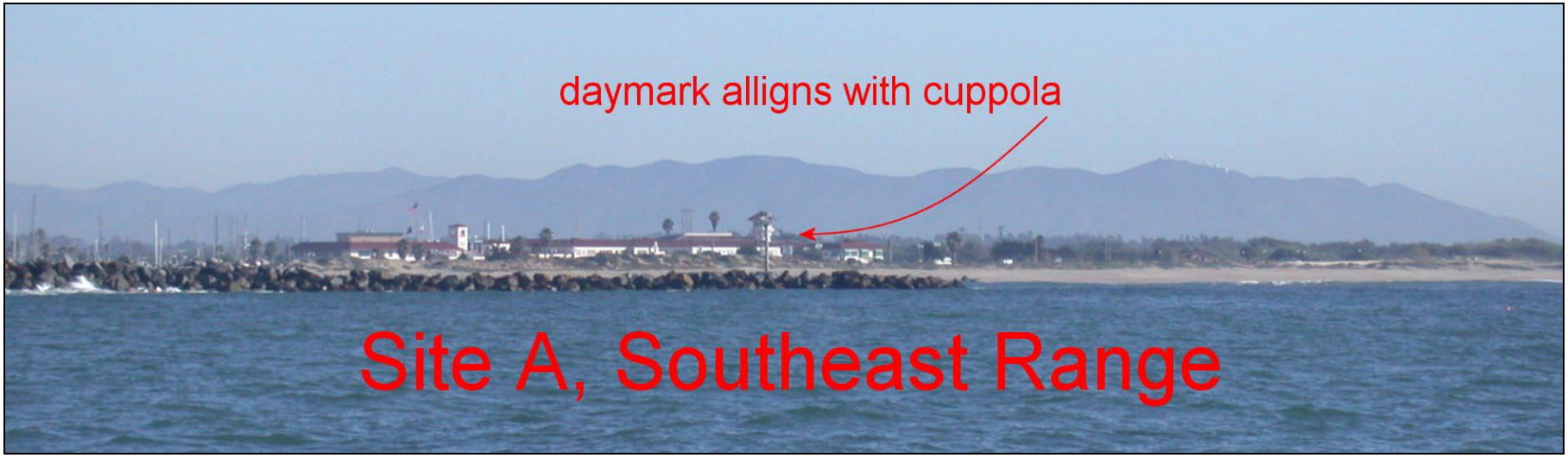

daymark alligns with cuppola
Site A, Southeast Range

PLATE A

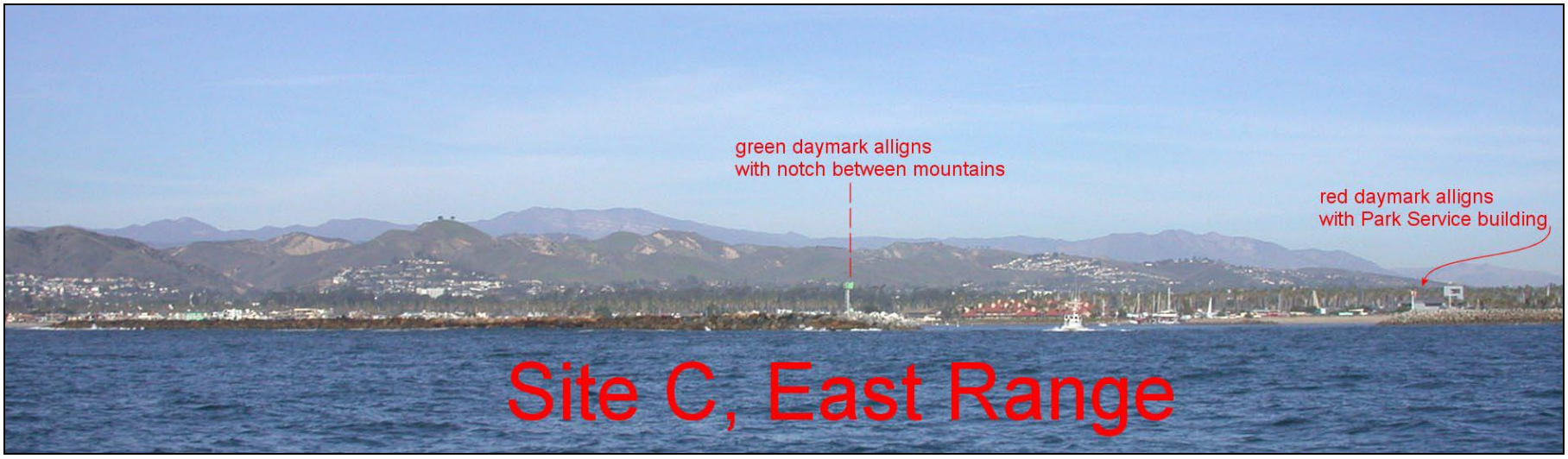
NOTES


groin between these two houses
Site B, East Range


red daymark just west of tower
Site B, Southeast Range

PLATE B

NOTES


green daymark alligns
with notch between mountains
red daymark alligns
with Park Service building
Site C, East Range

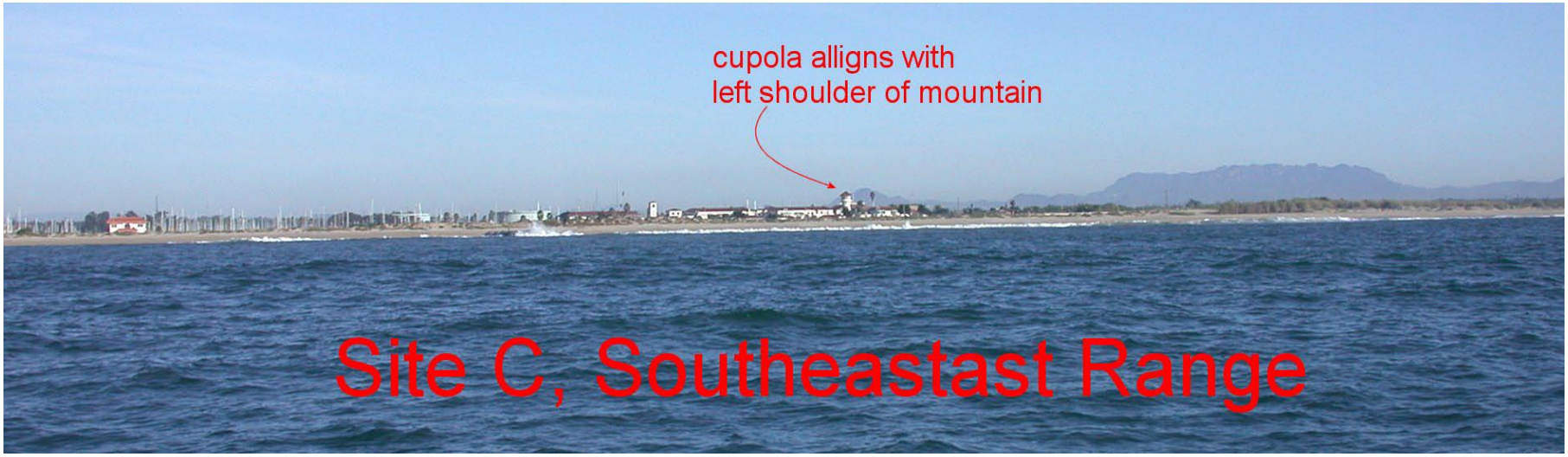

cupola alligns with
left shoulder of mountain
Site C, Southeastast Range

Plate C

NOTES