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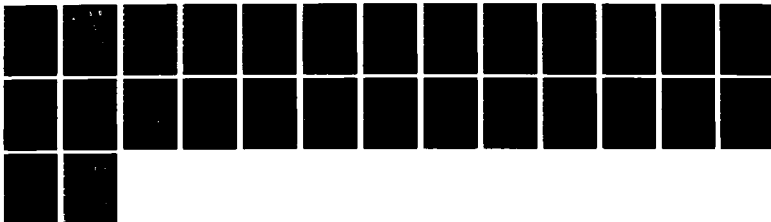
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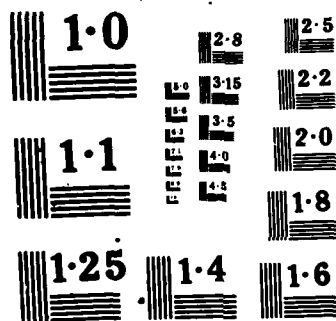
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DIEGO GARCIA PROJECT DOCUMENTATION REPORT

FEBRUARY 1985

**OCEAN ENGINEERING
AND CONSTRUCTION PROJECT OFFICE
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, DC 20374**

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During April and May 1980, two Buoy Dolphin systems were installed in Diego
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PROJECT DOCUMENTATION REPORT

DIEGO GARCIA 1984

FLEET MOORING PROJECT

A. INTRODUCTION

In 1980,
During April and May 1980, two Buoy Dolphin systems were installed in Diego Garcia, ~~BIOT~~ ^{British Indian Ocean Territory}, to better enable large ships to moor alongside the newly constructed Petroleum, Oil, and Lubricant (POL) Pier. These buoys were positioned about 175 feet from either end of the pier and have been used to secure the bow and stern lines of ships whose lengths exceed that of the pier. In early 1981, 11 fleet moorings were installed in the Diego Garcia lagoon to support the Navy's new Indian Ocean requirements. These latter 11 moorings consisted of 4 different classes of moorings comprised of 17 buoy systems.

B. MANAGEMENT SUMMARY

1. Background. Based on underwater inspection results and a reassessment of fleet mooring requirements, the Pacific Division, Naval Facilities Engineering Command (PACNAFACENGCOM) undertook ^{coordination} fleet mooring maintenance actions in Diego Garcia in November 1984. These actions included: the removal of four fleet moorings, the installation of cathodic protection (zinc anodes) on the wire rope anchor pendants which were to be left in place when these moorings were removed, the change out of five other buoys, and the replacement of an anchor

chain subassembly of the POL-S Buoy Dolphin. PACNAVFACENGCOM assumed management of the project, provided funding, and in August 1984, requested that the Chesapeake Division, Naval Facilities Engineering Command (CHESNAVFACENGCOM), Ocean Engineering and Construction Project Office, Code FPO-1, provide engineering support for the project.

2. Organization Responsibilities. The planning of the Diego Garcia project included close liaison between CHESNAVFACENGCOM and PACNAVFACENGCOM. In addition, the latter maintained contact with all other activities involved in the project. As a result of this detailed communication, the project was successfully completed as planned.

The overall responsibilities of the major activities involved in this project were as follows:

a. PACNAVFACENGCOM Responsibilities.

- (1) Manage the overall project.
- (2) Provide financial support.
- (3) Develop requirements and criteria.
- (4) Provide onsite project management and liaison between all activities involved.
- (5) Acquire required fleet mooring components from existing ready reserve inventories.

b. CHESNAVFACENGCOM Responsibilities.

- (1) Develop an execution plan required for the repair of the North and South POL moorings and to remove and change out other moorings.
- (2) Modify the POL Buoy Dolphin design to allow for more standard overhaul procedures.
- (3) Provide onsite engineers to conduct the repairs of the two Buoy Dolphins and any other engineering efforts required for other fleet mooring work.
- (4) Conduct a visual inspection of recovered fleet mooring components to identify unsatisfactory material and to prepare inventory documentation.
- (5) Provide a list of materials and equipment required to remove, repair, inspect, and maintain these fleet moorings.

c. NSRF Subic Responsibilities.

- (1) Provide all personnel required to operate the YD-241 floating crane and all riggers, equipment, and material required to complete the project.

d. NSF Diego Garcia Harbor Operations Responsibilities.

- (1) Provide the 60-ton YD-241 floating crane, as well as two YCs, a yard tug, and two LCMs.
- (2) Provide a berth for offloading the YCs and a staging area near the berth for temporary storage of recovered mooring material.
- (3) Provide liaison between the Base Operations Support (BOS) contractor (FEBROE) and other Project personnel.
- (4) Advise all concerned activities (by message) when the mooring material inventory has been shipped from Diego Garcia.

e. NSF Diego Garcia Dive Locker Responsibilities.

- (1) Work on the deck of the YD assisting the riggers for training purposes.
- (2) Provide a small utility craft to assist in mooring removals and repairs, and as a dive platform.
- (3) Provide diving services as required.

f. PWC Subic Bay Responsibilities.

- (1) Ship four refurbished buoys (two peg-top types with hawsepipes and two drum tension bar types) to Diego Garcia prior to the commencement of the project.
- (2) Advise all concerned activities (by message) of the receipt of the recovered mooring material from Diego Garcia.
- (3) Conduct a preliminary inspection of the recovered material, refurbish that material considered satisfactory for further fleet use, and accept this material into inventory.

g. BOS Contractor (FEBROE) Responsibilities.

- (1) Interface with Harbor Operations.
- (2) Provide workboat crew/operators.
- (3) Offload recovered fleet mooring inventory from YC barges to shore, transport this material to the designated staging area, disassemble the material into components, and prepare this material for shipment to PWC Subic Bay.
- (4) Provide a mobile crane and a lowboy trailer when required.
- (5) Transport mooring material from the staging area to the MSC shuttle ship and load aboard for shipment to PWC Subic Bay.

3. Project Site. Diego Garcia is located in the north central Indian Ocean approximately 7 degrees south of the equator. The island is a coral atoll with an enclosed lagoon about 8 1/2-miles wide by 13-miles long. The closest land mass is southern India, 1200 miles to the north. The island is owned by the United Kingdom, and a bilateral agreement allows the U.S. to occupy the western half (see Figure 1).

The designated mooring area in the lagoon averages about 90 feet in depth. The bottom consists of unconsolidated calcareous sand and silt composed of shell fragments and coralline debris.

4. Project Planning Summary. The specific requirements to be accomplished during this Fleet Mooring Maintenance Project are detailed in the "Diego Garcia Project Execution Plan (PEP)," Report Number FPO-1-84(38), of November 1984. All participating activities received copies of this document prior to the commencement of the project. If desired, additional copies of the PEP can be obtained from CHESNAVFACENGCOM. This PEP was extensively used and contained detailed guidelines for the project work completed during November 5 through 30, 1984, in Diego Garcia.

As a follow-on effort, it is planned that upon receipt of the recovered mooring components from Diego Garcia, PWC Subic Bay personnel will initiate a preliminary inspection of this material, document the condition of the material, recommend its disposition, and report their findings to NAVFACENGCOM.

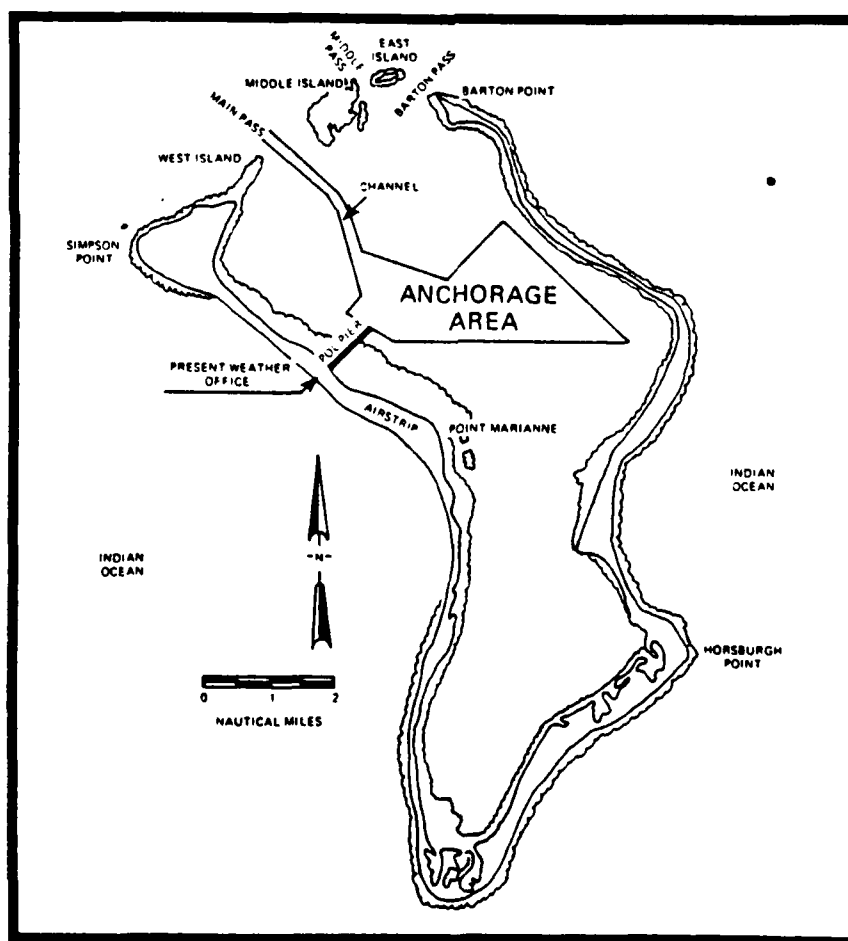
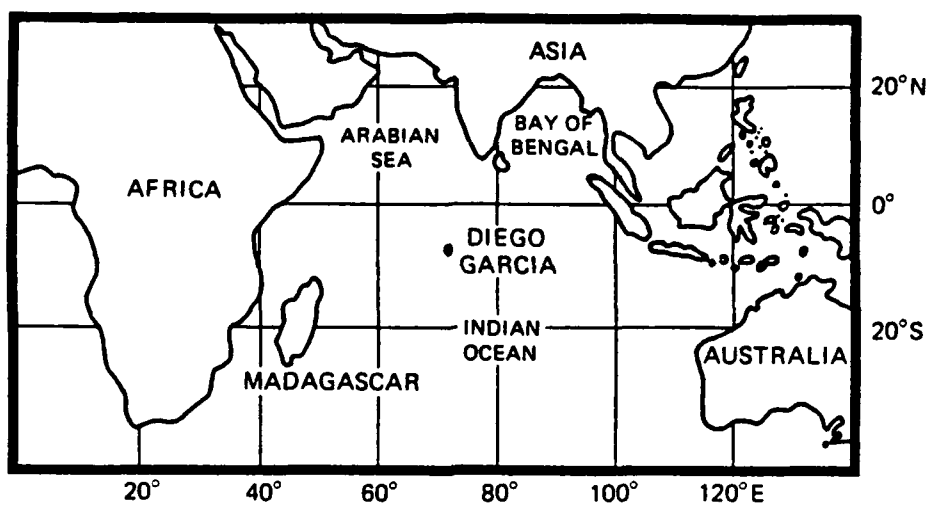


FIGURE 1. Diego Garcia

C. SYSTEM DETAILS

1. Geographical Data. The locations of the moorings installed in the lagoon at Diego Garcia are shown in Figure 2. The four moorings that were removed have been circled.

2. Mooring Descriptions. The following are descriptions of the four types of moorings that were removed and/or repaired during this project.

- a. Cargo Free-Swinging. Six Cargo Free-Swinging Moorings were installed in the lagoon at Diego Garcia (Moorings 1 through 6). Each of these moorings is a riser type and includes a MK II Peg-Top Buoy, chain swivel, riser chain subassembly, ground ring, three 540-foot anchor chain subassemblies with sinkers, wire rope anchor pendants, and three 100 KIP propellant embedment anchors. The buoy and chain subassemblies of these moorings are cathodically protected with zinc anodes and wire rope continuity cable systems. Figure 3 is an isometric drawing of this type of mooring system.

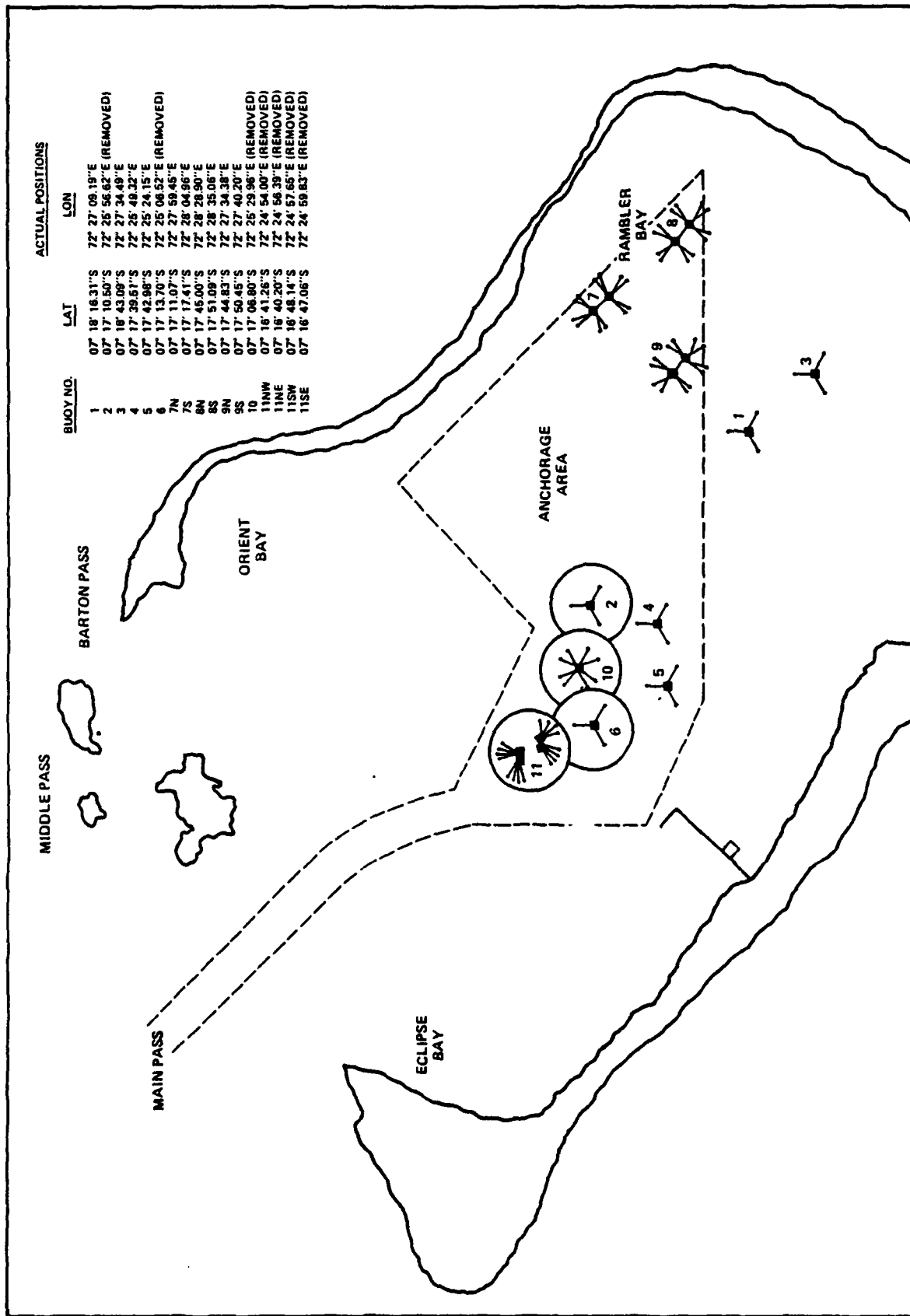


FIGURE 2. Geographic Positions Of Fleet Moorings At Diego Garcia

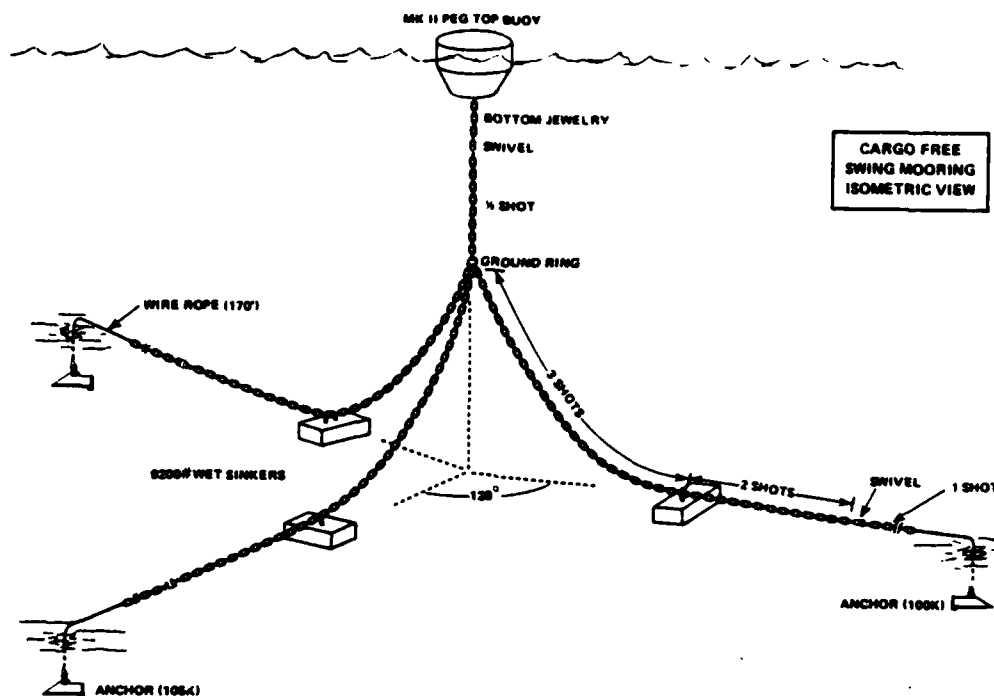


FIGURE 3. CARGO FREE-SWINGING MOORING

- b. Tender Free-Swinging. Mooring 10 was the only Tender Free-Swinging Mooring installed at Diego Garcia. This mooring consisted of a single 16-foot telephone buoy, four 2 3/4-inch equalizers attached to the buoy padeyes, and four ground leg pairs. Each leg of a leg pair consisted of 3 1/2 shots of chain, 25,000 pounds of sinkers, 170 feet of 2 1/4-inch wire rope, and a 150 KIP propellant embedment anchor. Figures 4 and 5 are isometric drawings of this mooring.

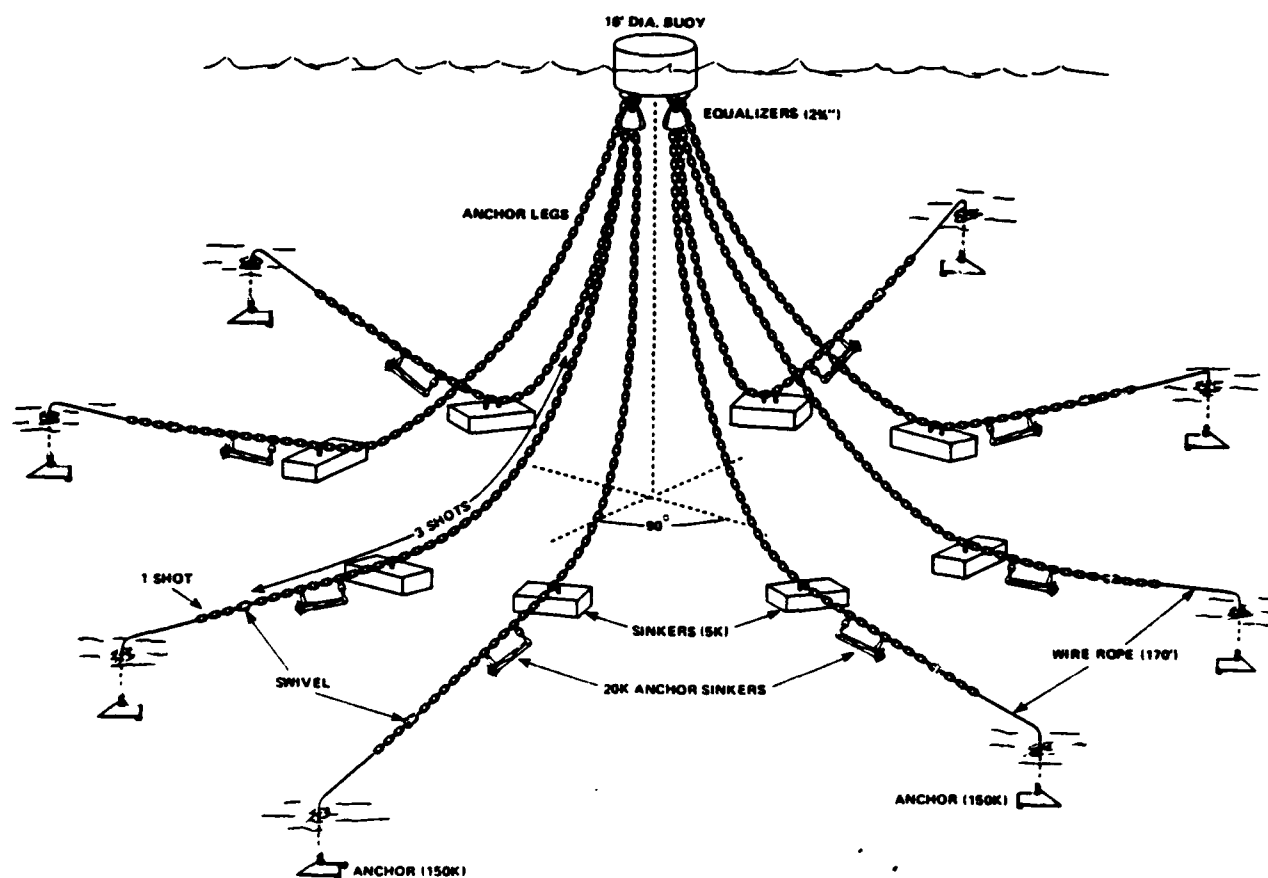


FIGURE 4. TENDER FREE-SWINGING MOORING

- c. Tender Bow/Stern. The Tender Bow/Stern Mooring consisted of four buoy systems (Buoys 11NE, 11SE, 11SW, and 11NW). Each buoy system consisted of a non-riser buoy and a large (3 3/4-inch) equalizer attached to the buoy's tension bar. A shot of 3 3/4-inch chain passed through this equalizer with a 2 3/4-inch equalizer attached to each end of the chain. A ground leg pair passed through each of

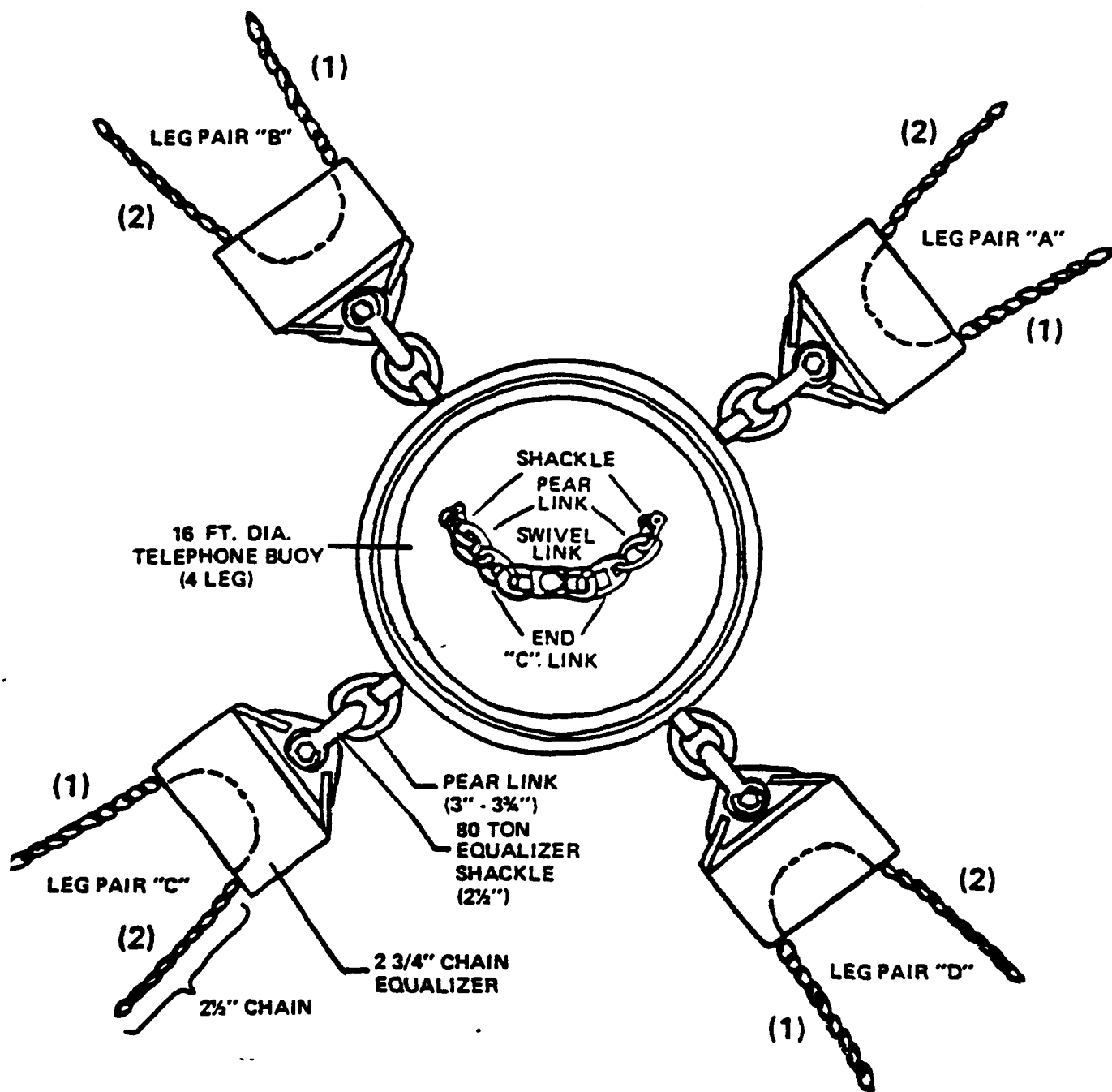


FIGURE 5. Tender Free Swinging Mooring

these equalizers. Each leg of a leg pair contained 3 1/2 shots of chain, 25,000 pounds of sinkers, 170 feet of 2 1/4-inch wire rope, and a 150 KIP embedment anchor. In addition, each buoy had a two-shot backstay leg attached to the padeye opposite the direction of the anchor chain subassemblies and anchors. The lower three shots of each half of a leg pair and the backstay leg were cathodically protected. Figures 6 and 7 are isometric views of a typical buoy system of this mooring.

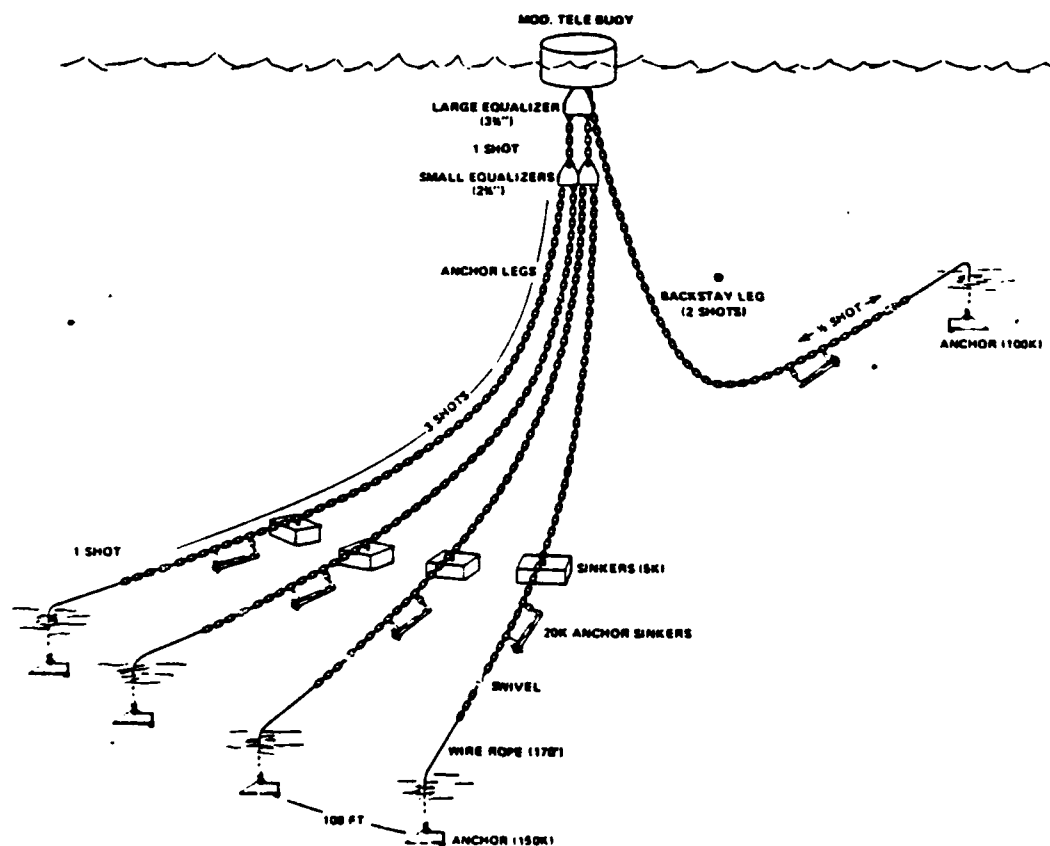


FIGURE 6. TENDER BOW/STERN MOORING

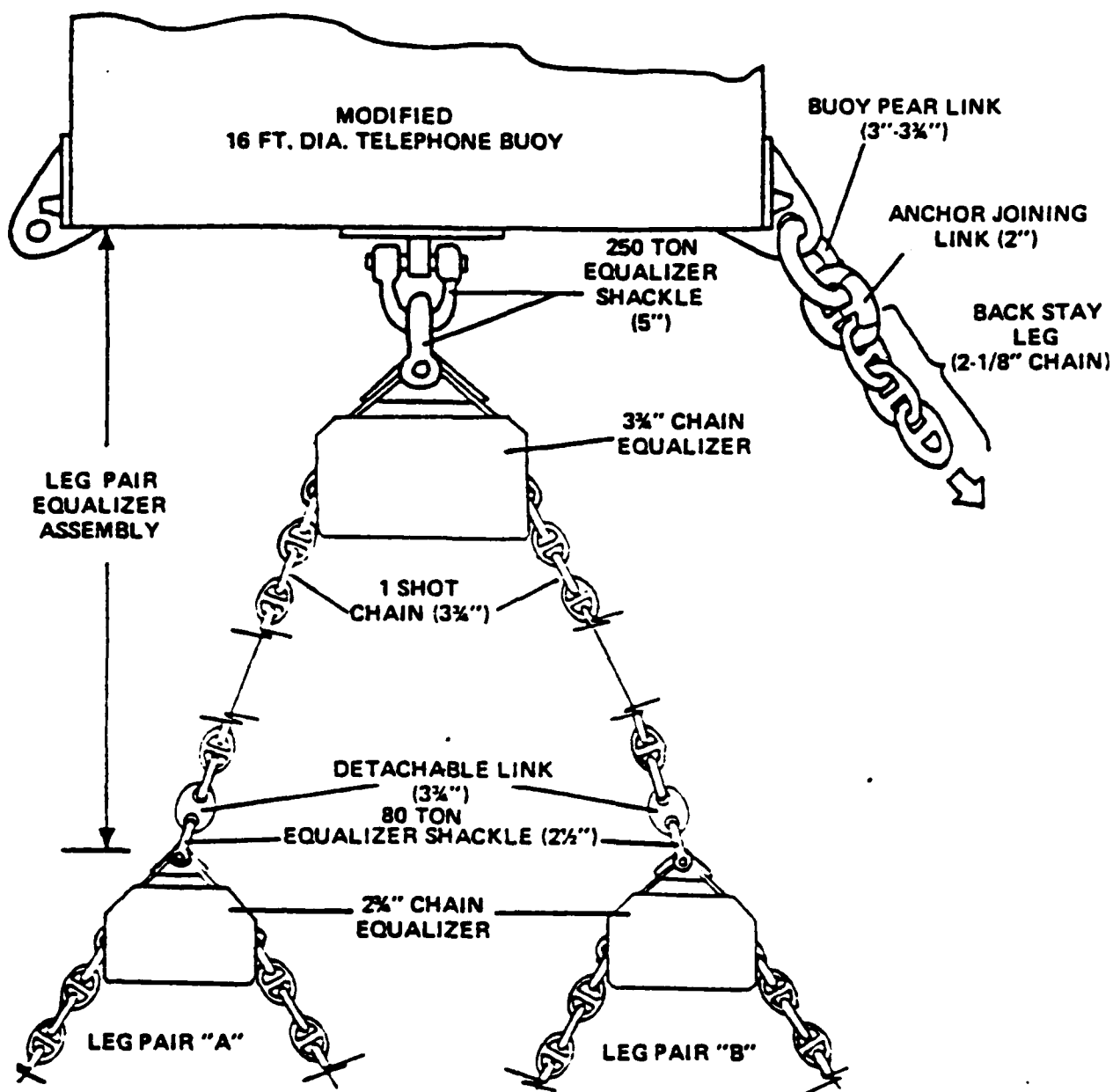


FIGURE 7. Tender Bow/Stern Mooring

- d. Buoy Dolphin System. Each Buoy Dolphin system contained a standard peg-top buoy, modified by the addition of a skirt which gives the buoy a cylindrical shape and provided greater buoyancy. Each buoy was filled with foam. These buoys were changed out with standard peg-top buoys.

Each of the two systems contains a riser assembly, ground ring, and five legs - a single ground leg, a ground leg pair passing through an equalizer, and two backstay legs attached to a spider plate. The lower end of each of the five legs is attached to a 2-inch wire rope anchor pendant leading to a 100 KIP propellant embedment anchor. See Figure 8 for a schematic of a typical Buoy Dolphin system.

Both Buoy Dolphin systems are cathodically protected. There are two anodes attached by brackets to the bottom of each buoy and two attached to the 20K anchor clump shackled to each chain leg. Three quarter-inch wire rope continuity cable is woven through each of the five legs and clamped to the chain and to the anodes on the anchor clumps.

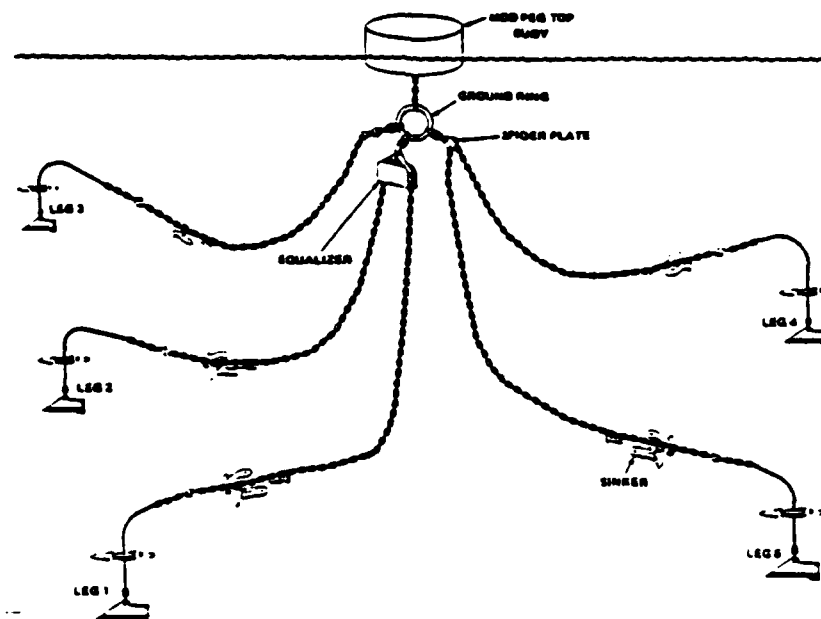


FIGURE 8. BUOY DOLPHIN SYSTEM

D. PROCEDURAL DETAILS

1. Project Summary. This fleet mooring project was accomplished in three phases which included the recovery of four moorings, the change out of three other buoys, and the repair/modification of the two Buoy Dolphins.

Phase 1. The following moorings were recovered:

Mooring 2 (Single Buoy System),
 Mooring 6 (Single Buoy System),
 Mooring 10 (Single Buoy System), and
 Mooring 11 (Four Buoy Systems).

Phase 2. Changed out buoys on Moorings 1, 3, and 5.

Phase 3. Changed out the North and South POL Buoys. Inspected and reinstalled the anchor chain on South Buoy Leg S-3.

2. Project Milestones. The following is a chronology of the events that took place during this project. All dates are calendar year 1984.

SEPTEMBER

20-27 Predeployment meetings in Diego Garcia.

28-30 Predeployment meetings in Subic Bay.

OCTOBER

1-2 Predeployment meetings in Subic Bay.

NOVEMBER

5 Project team arrived in Diego Garcia.

6 Briefings with all concerned operational personnel. Removed two buoys near the sand pier and Navigational Buoy No. 9, each under the control of Harbor Operations.

7	Removed Mooring 2.
9	Removed Mooring 6.
10-12	Removed Mooring 10.
13-23	Removed the four buoy systems of Mooring 11 and changed out Buoy No. 5.
24	Changed out buoys on Moorings 1 and 3.
25-27	Changed out buoys of POL-N and POL-S and inspected Leg S-3.
28	Demobilization.
29	Debriefings in Diego Garcia.

DECEMBER

3-5	Debriefings in Subic Bay.
10-11	Debriefings at PACNAVFACENGCOM.

3. Mooring Recovery. The recovery of Moorings 2, 6, 10, and 11 was accomplished in accordance with the PEP, with minor exceptions:

- a. Wire rope slings, were selected to be used to stopper off the chain rather than the sinker shackle stoppers described in the Plan,
- b. Each time a leg was removed, the buoy was placed back in the water with the remaining legs still attached. This was different from the PEP which proposed to remove the buoy as the first step, attach retriever buoys to each leg, and place all legs back into the water to await recovery.

- c. The wire rope pendants of the four backstay legs from Mooring 11 failed to reach the surface. Two of these legs required divers to use explosives to cut the chain.

4. Cathodic Protection. After separation of an anchor chain subassembly from its wire rope anchor pendant, an anode was attached to each pendant. Initially, the 250-pound zinc anodes were attached according to the PEP. As the weather deteriorated, the wire rope was stoppered off and layed on deck so that the anode could be attached more easily. Finally, it was decided to use divers to attach the anodes after the pendants were lowered to the bottom. Subsequent to the installation of the anodes, underwater voltmeter readings were taken by NSF Dive Locker personnel, and were all within the acceptable ranges to ensure proper cathodic protection.

5. Buoy Changeout. The buoys of Moorings 1, 3, and 5 were changed out. There were no deviations from the PEP during these operations. Although Mooring 5 was initially scheduled for recovery and storage, due to operational requirements, CINCPACFLT changed this requirement, and made the decision to leave this mooring in the water.

The buoys of POL-N and POL-S were replaced as detailed in the PEP with minor changes. Caliper measurement of the 3 1/2-inch risers showed no significant wear or loss due to corrosion and the risers were not replaced. The new buoys (peg-top types with hawsepipes) were attached directly to these risers.

6. South POL Buoy Dolphin. Leg S-3 of this Buoy Dolphin had been previously reported to be in poor condition and was scheduled for replacement during the conduct of this project. This leg was disconnected from the ground ring and underrun until the anchor sinker was above water. Caliper measurements, both double- and single-link, showed no areas of abnormal wear. The leg was considered to be in satisfactory condition for continued use, was reattached to the ground ring, and the mooring was replaced in the water.

7. Inventory Marking. Recovered shots of chain destined for fleet mooring inventory storage were each marked with a metal tag which was stamped as shown in Figure 9.

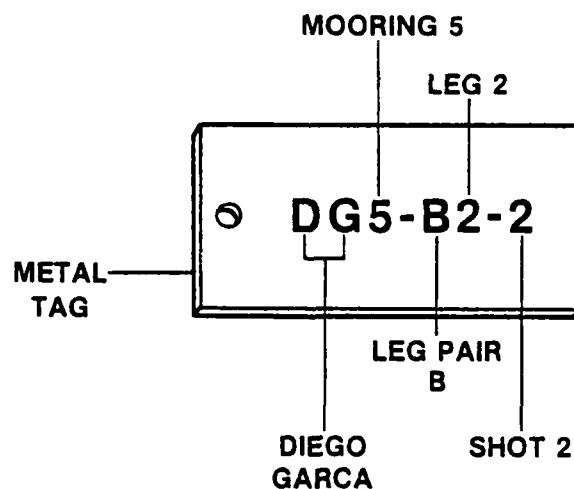


FIGURE 9. INVENTORY MARKING TAG

8. Inventory Shipment. The recovered chain was separated into shots or partial shots, cleared of wire rope and other extraneous material, and bundled. With the exception that the wire rope was reeved through each of the center links, Figure 10 depicts the bundling procedure followed.

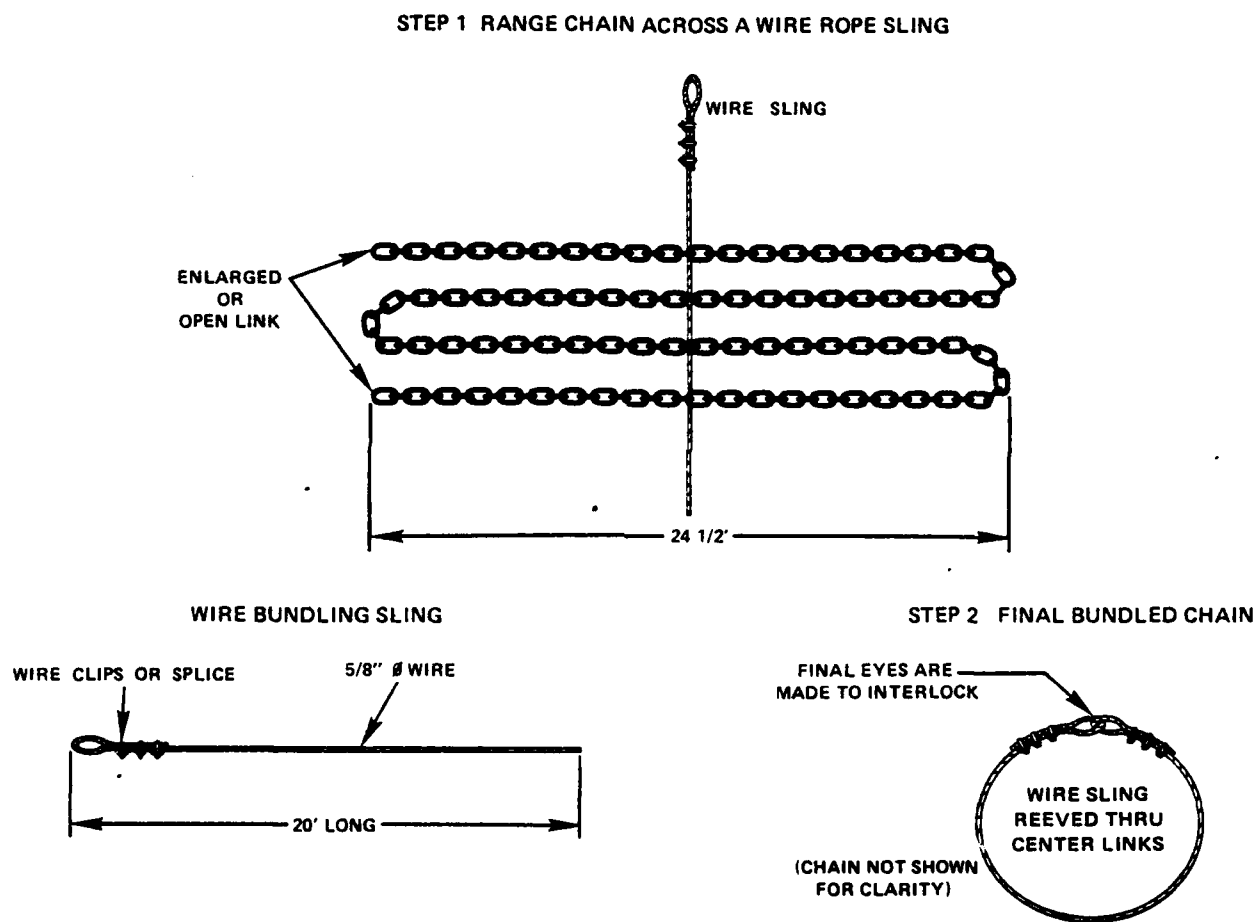


FIGURE 10. BUNDLING CHAIN

Recovered mooring chain accessories (detachable links, end links, ground rings, etc.) were grouped together by types and sizes and bundled with a single wire rope passed through each accessory. This material was then arranged by type of component and placed on pallets in the storage area to await shipment to Subic Bay.

9. Recovered Inventory. The quantity of mooring material recovered is in the process of being shipped to Subic Bay where it will be stored in Fleet Mooring Inventory. The major material recovered included:

- a. Over 15,000 feet of chain (sizes varying from 2-inch to 3 3/4-inch diameter) with an estimated weight of 950,000 pounds.
- b. Twenty-eight 20,000-pound Navy Standard Stockless Anchors (used as anchor sinkers).
- c. Five 16-foot diameter telephone-type buoys.
- d. Three 12-foot diameter peg-top type buoys.
- e. Two 12-foot diameter modified peg-top type buoys.
- f. Twenty-three 5,000-pound concrete sinkers.
- g. Six 9,200-pound concrete sinkers.

h. Twelve 2 3/4-inch and four 3 3/4-inch chain equalizers.

Due to time constraints, the chain accessories recovered (i.e. shackles, anchor joining links, detachable links, ground rings, etc.) were not inventoried during the recovery operations. An inventory of these accessories will be conducted by PWC personnel when this material arrives at Subic Bay.

E. FOLLOW-ON DIEGO GARCIA EFFORTS

1. Subic Bay. All of the mooring material recovered from the lagoon at Diego Garcia will be shipped to PWC Subic Bay. Upon receipt, this material will be inventoried and a preliminary inspection conducted. Those mooring components considered to be in satisfactory condition and which meet the criteria for further fleet operational usage shall be refurbished and placed into storage. This material will become part of the Fleet Mooring Inventory.

2. Diego Garcia. At the present time, PACNAVFACENGCOM plans to complete the changeout of the remaining original mooring buoys in Diego Garcia. This will include the changeout of the buoys in Moorings 4, 7, 8, and 9. It is anticipated that these maintenance actions will take place in FY86 or FY87.

F. SUMMARY

The Diego Garcia Project resulted in the recovery of several million dollars worth of badly needed mooring material. In addition, the removal of

these four moorings provides an unobstructed channel for use by vessels transiting to and from the main anchorage area.

The Project Team completed the desired mooring maintenance actions ahead of schedule despite some adverse environmental conditions and additional work requirements.

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