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## Abstract

This report contains the results of the inspection of the fleet mooring located near Gaeta, Italy. A CHESNAVFACENGCOM-assigned Engineer-in-Charge and divers from Underwater Construction Team One conducted the inspection during the period 15-24 September 1983.

This mooring consists of bow and stern buoy systems. In the bow mooring buoy system, the buoy is in poor condition and should be overhauled or replaced. The stern buoy system is in good condition. Specific comments concerning the current condition of the mooring is contained herein.

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## NAVAL SUPPPORT ACTIVITY NAPLES

## (GAETA) FLEET MOORING UNDERWATER

#### INSPECTION REPORT

#### 1.0 INTRODUCTION

1.1 <u>Background</u>. Under the COMNAVFACENGCOM Fleet Mooring Maintenance (FMM) Program, CHESNAVFACENGCOM has been assigned the responsibility to plan and conduct periodic diver inspections of all fleet moorings worldwide. In carrying out this responsibility, CHESNAVFACENGCOM designated an Engineer-In-Charge (EIC) to provide inspection planning and onsite technical direction for the underwater inspection of the fleet mooring located at Gaeta, Italy. The actual underwater portion of the inspection was performed by divers of Underwater Construction Team One. The inspection was conducted between 15-24 September 1983.

## 1.2 General Mooring History.

For many years, the fleet mooring located at Gaeta, Italy, has been used to moor the flagship of the Commander, Sixth Fleet. Currently, this is USS PUGET SOUND (AD 38). This mooring consists of bow and stern buoy dolphins which are used by the ship to maintain its position when breasted alongside two finger piers attached to the main pier. The geographic locations of Gaeta, its main pier, and the fleet mooring are shown in Figures 1 through 3.

During 1978, the bow buoy system was dragged during heavy weather resulting in significant ship-caused damage to the pier and its fendering system. A replacement buoy dolphin system, using two propellant embedment anchors (PEAs), was installed during November 1978. Suspended beneath the buoy is a chain equalizer through which 80 feet of chain passes. Attached to each end of this chain is 100 feet of 1 3/4-inch wire rope anchor pendant, which leads to a 100K mud-fluke-type PEA. The chain equalizer, which is cathodically protected by attached zinc anodes, is capable of handling 2 1/4-inch chain. However, the chain currently used is 1 3/4-inch chain that was salvaged from the previous bow mooring installation. The two PEAs are buried about 40 feet below the mud line. Figure 4 is a schematic drawing of the bow buoy dolphin system while Figure 5 is a drawing of the designed configuration of the stern buoy dolphin system.

## 2.0 INSPECTION PROCEDURES

2.1 <u>Inspection Objectives</u>. The purpose of the mooring inspection was to determine the general physical condition of the buoys and chain assemblies and, when possible, to verify or update existing as-built and maintenance records. Divers inspected only a portion of the submerged buoy hull and chain assemblies in order to compile a general description of the mooring's condition. The existence of fairly consistent measurements during this inspection provides a good indication of the mooring's overall condition. It should be kept in mind that periodic underwater inspections are intended as an expedient and relatively inexpensive supplement to accurate maintenance records. As such, they

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Figure 2. Gaeta Pier Location





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cannot fully substitute for a complete inspection involving recovery of the mooring and the measurement and evaluation of each component.

Chain wire diameter measurements are used to evaluate the condition of a mooring. After cleaning to bare metal, a selective sampling of the wire diameter of chain links and connecting hardware was taken in order to determine the amount of deterioration due to corrosion and wear. "Single link" measurements were taken where chain was slack, to detect corrosion loss. "Double link" measurements were taken where two links connect under tension to detect the combined effects of corrosion and wear. Chain links and other components which measured 90 percent or greater of original wire diameter are considered to be in "good" condition; measurement between 80 percent and 90 percent of original diameter is considered "fair" condition and is cause for the mooring to be downgraded in classification; any measurement less than 80 percent is considered "poor" and is cause for the mooring to be declared unsatisfactory for fleet use.

PEA pendants were checked for kinks, broken strands, unravelling ("birdcaging"), excessive wear, or other damage. Where visible, the anchor pendant fittings were inspected for overall condition and measured to determine the effects of wear and corrosion.

Standard underwater inspection procedures do not call for the inspection of any part of the mooring which is buried. Ground legs and risers are observed only to the point at which they become buried; no attempt is made to locate and inspect anchors or other mooring materials which are not readily visible.

The following paragraphs contain the general inspection procedures that were followed:

## 2.2 Bow and Stern Buoys.

2.2.1 <u>Buoy Upper Portion</u>. Each of the two buoys was examined to determine its general condition. Its diameter and height were recorded. The paint was checked for cracking, chipping, and peeling.

The buoy fenders and chafing rails were checked for integrity and secure connection to the buoy.

Buoy top jewelry was identified and measured with calipers to find the overall dimensions and areas of most severe reduction in wire size.

2.2.2 <u>Buoy Lower Portion</u>. Divers thoroughly inspected each buoy below the waterline. The thickness of marine growth was recorded, several areas were selected and cleared of growth, and the condition of the paint was noted.

## 2.3 Bow Anchor Legs.

2.3.1 <u>Chain Equalizer</u>. Divers checked the equalizer for overall condition and looked for evidence of wear. The cathodic protection system which was attached to the equalizer during the mooring's installation in 1980 was also inspected and its condition noted.

2.3.2 <u>Chain</u>. On both sides of the chain passing through the equalizer, double link measurements were taken just below the equalizer, at the end of the chain, and about halfway in between.

2.3.3 <u>Chain Anchor Pendant Connections</u>. The divers identified the swage fittings and other chain accessories used to attach the chain to the wire rope anchor pendants. Measurements of this material were taken.

2.3.4 <u>Anchor Pendants</u>. The divers swam down the two wire rope pendants from the upper swage fittings to the points at which these ropes entered the bottom, checking for kinks, unravelling, broken strands, and other damage to the wire.

2.4 Stern Riser and Ground Legs.

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2.4.1 <u>Riser</u>. Double link measurements using pre-cut go/no-go gauges were made at both ends and near the center of the riser. The swivel and detachable links contained within the riser assembly were visually inspected and measured.

2.4.2 <u>Ground Ring</u>. The ground ring was examined for general and localized wear. Caliper measurements were made of the wire size in the region of most severe wear. The anchor joining links connecting the riser, two ground legs, and concrete clump to the ground ring were inspected and their wire diameters measured.

2.4.3 <u>Concrete Sinker</u>. The 15-ton sinker's hairpin was inspected for wear and caliper measurements of its wire diameter taken. The general condition of the visible portion of the sinker was noted.

2.4.4 <u>Chain Legs</u>. Double link measurements of the upper portion of each leg were taken. Only a few feet of each of the two ground legs were visible.

2.4.5 Anchors. The anchors were not visible for inspection.

3.0 INSPECTION SUMMARY

An in-depth discussion of the inspection results is presented in Annex A, and the repair work accomplished by the inspection team is described in Annex B. Annex C contains photographs, and Annex D is a copy of the preliminary report of the results of the inspection as well as other reference material.

The data gathered during the inspection is summarized below.

## 3.1 Bow Mooring

- o The buoy is unpainted, is badly rusted and pitted, and has no chafing rail. Overall, the buoy is in poor condition.
- o The equalizer chain was measured to be greater than 90 percent of its original 1 3/4-inch diameter.
- The four zinc anodes that were attached to the equalizer 5 years ago were found to be fully expended. The zincs were replaced as described in Annex B.

- o The equalizer and the upper portion of the equalizer chain are covered with a heavy coating of marine growth.
- o About 5 feet of the 1 3/4-inch anchor pendant (just below the swage fitting that attaches the pendant to the equalizer chain) was found to be damaged and corroded down to 1 1/4 inches. The damaged section of the wire rope anchor pendant was replaced (see Annex B) by UCT One personnel.
- o The anchors were not visible for inspection.
- o The bow mooring is reportedly too close to USS PUGET SOUND.

## 3.2 Stern Mooring.

- o The stern buoy is in good condition.
- o The riser, ground ring, and upper portion of the two ground legs were all measured to be greater than 90 percent of their original 2-inch diameter.
- o No cathodic protection materials were observed.

## 4.0 CONCLUSIONS AND RECOMMENDATIONS

## 4.1 Bow Mooring.

- o The buoy should be removed from the water and overhauled at the earliest practical time. In general, however, the mooring is in satisfactory condition for continued use.
- o The position of the bow buoy system should be reviewed as part of the transition planning for the new Flagship. Preliminary indications are that the buoy will be better positioned for USS CORONADO than for USS PUGET SOUND, but the issue deserves further attention.

## 4.2 Stern Mooring.

o Overall, the stern mooring is in good condition.

ANNEX A

MOORING INSPECTION RESULTS

CHESNAVFACENGCOM REPORT FPO-1-83(46), "NSA NAPLES FM UNDERWATER INSPECTION REPORT."

#### GAETA BOW MOORING

INSPECTION RESULTS

#### Buoy.

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This is an  $11 \frac{1}{2}$ -foot diameter can-type buoy with a tension bar. The buoy stands 4 3/4-feet high and has a single wooden fender at the waterline. It is unpainted, is badly rusted and pitted, and has no chafing rail. The top and bottom shackle-type jewelry are in satisfactory condition. Overall, the buoy is in rather poor condition.

#### Equalizer.

The equalizer is in good condition, but as evidenced by heavy marine growth, the chain passing through it has probably not moved for several years. The four sacrificial zinc anodes that were attached to the equalizer when the mooring was installed in November, 1978, were found to be fully expended. The cause of this relatively rapid decay of the anodes is unknown.

## Equalizer Chain.

The chain was originally 1 3/4-inch diameter and all measurements taken were greater than 90 percent of the original wire diameter. Between the surface and a water depth of 25 feet, the chain is covered with a heavy coating of marine growth. The chain is not centered in the equalizer, so that the southern leg is 28 feet long and the northern leg is 52 feet long (see Figure A-1).

## Anchor Pendants.

Each of the anchor pendants attached to each end of the chain passing through the equalizer consists of two 50-foot sections of 1 3/4-inch steel wire rope. The bitter end of each anchor pendant is connected to a 100 KIP PEA. About 5 feet of the southern anchor pendant, just below the swage fitting which attaches the pendant to the equalizer chain, was found to be damaged and necked down to approximately 1 1/4 inches, or about 71 percent of original wire diameter. Of these two 100-foot lengths of wire rope less than half of each was visible for inspection.

## Anchors.

The anchors were not visible for inspection.

#### Comment/Recommendation.

Although this mooring is in satisfactory condition for continued use, the buoy should be removed from the water and overhauled at the earliest practical time.

CHESNAVFACENGCOM REPORT FPO-1-83(46), "NSA NAPLES FM UNDERWATER INSPECTION REPORT."



CHESNAVFACENGCOM REPORT FPO-1-83(46), "NSA NAPLES FM UNDERWATER INSPECTION REPORT."

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MATER DEPTIS				:			18		-	BUOY LOCATION
BOLLOM LYPE: COMPON BUIOY LIAF AQU SAFETYSHIR		NA I	ICHOR S	IZE/TYPE:	IDOK	PEA		UUV I YP	ECAN	TYPE WITH TENSION BAR
COMPONI BUOY HAR ROW SRFETY			aum 🏾		LAY		JAL	ROC	K Visil	bility $\frac{3}{3}$ D = depth NI = not inspected, inaccessible
COMPONIAN BURY LIAN ROW SRFETY					3	NDITIO	Z			
BUIOY HAP ROW SAFETY SAFETYSAM		Ē	NEW	SINGL	E LINK %		DOUBLE	LINK %	a	COMMENT
BUIDY HAR ROW SRFETY SRETYSHHO			L	80+ B(	94 +0		96	08 +		
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SHEETYSHHC	SHACKLE (TOP)		3% = 3% =							SEVERLY RUSTED AND PITTED, SINGLE
	KLE (BTH)									NOOD FENDER OK . NO CHAFILE EALL.
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FOUPLIZED						2	γ			3 YR OLD ZINCS WERE 100 6
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EQUALIZEN CHAIN MID	DLE					$\overline{Z}$	23.			1 34 " CHAIN WITH HEAVY MUSSEL GROUTH
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ddn	ER END									1 34 "WIRE EDGE WITH SWAGE FITTINGS
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ENI	ERS BOTTOM									CONDITION, ABOUT S'OF THE
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#### GAETA STERN MOORING

INSPECTION RESULTS

## Buoy.

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This is a 9 1/2-foot diameter can-type buoy with two wooden fenders. It also has a tension-bar and a riser. The paint, fenders, chafing rail, and top hardware are all in good condition.

## Riser.

The riser consists of 2-inch chain and all measurements taken were greater than 90 percent of the original wire diameter. The chain is covered with a heavy coating of marine growth (mussels). A swivel was located and found to be in good condition.

## Ground Ring.

A ground ring was found on the bottom at a water depth of 20 feet and its wire diameter measured 2 1/4 inches. The upper portion of a partially buried concrete sinker was observed attached to the ground ring by back-toback 2 3/4-inch anchor joining links.

## Ground Legs.

About 10 to 20 feet of the two ground legs were visible on the bottom before they entered the mud. These legs were oriented about 30 degrees apart and all chain measurements taken were greater than 90 percent of the original 2-inch wire diameter. No zinc anodes or continuity wire were visible.

## Anchors.

The anchors were not visible for inspection.

#### Comment/Recommendation.

This mooring system is in satisfactory condition for continued use as a fleet mooring.

CHESNAVFACENGCOM REPORT FPO-1-83(46), "NSA NAPLES FM UNDERWATER INSPECTION REPORT."

											1 EXACT BUDY LOCATION
анги ргь	·111: 20'		ANCHOR	SIZE/T	YPE:	<u>T</u> N		BUO	Υ ΤΥΡΕ:	RISER	TYPE WTENSION BAR
VI MOLIO	(PE: SAN	Q	JUM 🕅	-		∟ ≻	CORAL		] воск	Visib	llity $-2^{\prime}$ D = depth NI = not inspected, inaccessi
						CON	NOITION				
CON	APONENTS	Z	NEW	S	NGLE L	INK %	DO	UBLE LI	NK &	<u>م</u>	COMMENT
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KOUR	( HARDWARE										CAN TYPE BUDY. PAINT GODD, FENDER
PEAR	LINK		35								OK. FLOATING LEVEL-LUDER NO
SAFET	Y SHACKLE		3 %								HORIZONTAL LOAD, CHAFING RAIL OK.
											OVERALL DAVDITON GOOD. BUDY
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During the inspection, the positions of the two buoys were sighted from known benchmarks ashore. The accurate locations of these buoys are shown in Figure A-1.

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ANNEX B

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# REPAIRS ACCOMPLISHED DURING THE INSPECTION

## REPAIR OF BOW MOORING

## Installation of New Cathodic Protection System.

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Three 46-pound and four 25-pound sacrificial zinc anodes were available for installation. Two of the 46-pound zincs were attached with nuts and bolts to the outside of one equalizer plate while two of the 25-pound anodes were doubled up and attached to the outside of the second equalizer plate along with the third 46-pound anode.

One-half-inch continuity wire was then woven through the chain. The wire was attached with tie wraps in various locations where the chain had been cleaned to bare metal.

A 25-pound anode was mounted on each of the northern and southern anchor pendants, below the swage fitting which connects the anchor pendant to the equalizer chain. The 1/2-inch continuity wire was continued down from the chain and attached to each zinc anode. A schematic drawing of the cathodic protection system is depicted in Figure B-1.

Underwater voltmeter readings were taken at specific locations in the mooring and at various times during the installation, both with and without USS PUGET SOUND's impressed current system in operation. Table B-1 contains a copy of these readings.



	TABLE B-1.	BOW MOORING VOLT	METER READINGS	
	Initial readings with no zincs and impressed current off	Readings 24 hours after top zincs installed and impressed cur- rent off	Readings 24 hours after all zincs/ continuity wire installed and impressed current off	Readings with top zincs on, one bottom zinc on, and impressed cur- rent on
 	(mV)	(mV)	(mV)	(mV)
Buoy	.62	.71	.85	.86
Equalizer	•62	.91	.86	.91
Zinc on Equalizer	x	.97	.97	.97
Chain: Top	.62	.81	.86	.86
Middle	.62	.75	.77	.80
Bottom	.62	.74	.77	.76
Wire: Top	.62	.65	.75	
Mudline	.62	•65	.75	

## Replacement of a Section of Anchor Pendant.

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UCT One divers replaced the upper 50-foot section of the southern leg's anchor pendant. After removal of the damaged section, it was packed for shipment to the Naval Civil Engineering Laboratory (Attn: Mr. James Miller L42) for failure analysis. Shipment of the new anchor pendant from the United States to Gaeta took one week.

To accomplish the replacement, the following procedures were followed:

- A stopper was tied just below the swage fitting on the lower 50-foot wire section. A come-along was shackled into the lower end of chain. The hawser tension on the buoy from the ship was eased. Tension was pulled by the come-along to reduce tension in the upper 50-foot section.
- o The top swage pin dropped out easily, but the bottom pin was out-ofround and required several hours of bottom-time and use of a wheel puller to remove it.

 A new section of anchor-pendant wire was supported by three lift bags. The top end of the wire (open swage) was fair led with line through the bitter end of the chain. The top end lift bag was cut off and the wire pulled into place by the topside crew. The pin and cotter key were inserted.

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o The bottom end (closed swage) was fair led with line through the open swage of the bottom 50-foot length. The remaining lift bags were deflated and the wire pulled into place by the topside crew. The pin was inserted and secured by a 1/2-inch mild-steel nut and bolt. ANNEX C

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# PHOTOGRAPHS



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BOW MOORING. NOTE THE STEEP HAWSER ANGLE



BOW MOORING. NOTE THE RUSTING AND PITTING OF THE BUOY

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STERN MOORING UNDER LOAD



STERN MOORING UNDER LOAD



# SWIVEL IN RISER CHAIN OF THE STERN MOORING - GOOD CONDITION



BOW MOORING. NEW SOUTHERN LEG 1 3/4" WIRE ROPE ANCHOR PENDANT WITH A 25-POUND ZINC ANODE ATTACHED. ANNEX D

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# REFERENCES

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B. STERN MOORING: GOOD CONDITION.

C. BOW MOORING DESIGNED AND POSITIONED FOR USS ALBANY. INDICA-TIONS THAT BOW MOOR IS NOT OPTIMALLY POSITIONED FOR USS PUGET SOUND. RECOMMEND MOORING DESIGN REVIEW AS PART OF TRANSITION PLANNING FOR 'NEW FLAGSHIP.

2. ANTICIPATE DISTRIBUTION OF DETAILED INSPECTION REPORT IN DECEMBER 1983.

3. CHESNAVFACENGCOM POINT OF CONTACT IS LCDR G. H. SELTZER AT (202) 433-3881 OR A/V 288-6608.

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FM USS PUGET SOUND

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TO USS PUGET SOUND

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SUBJ: FLEET MODRING INSPECTION OF GAETA, ITALY

1. AS PART OF THE COMNAVFACENGEOM FLEET MOORING MAINTENANCE (FMM) PROGRAM, CHESNAVFACENGEOM, WITH DIVER SUPPORT FROM OCT ONE, PLANS TO COMPUCT AN UNDERNATER INSPECTION 10-17 SEPT 83 OF MOORING AT GAETA. RECURDS INDICATE TWO-POINT DOLPHIM HOURING SYSTEM SIZED FOR CGN/AD CLASS.

2. ADVISE IF ANY RECORDS OF MAINTEMANCE, OVERHAULS OR ALTS HELD BY PUGET SOUND.

3. REP ADVISE THISTA, CHESNAVEAC AND UCT UNE IF INSPECTION PERIOD SATISFACTURE ID OPS 3KD.

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