

Project Title: Squaw Mooring Installation

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Organizations/People Involved:

CHESDIV FPO-1
PWC San Diego
NCEL
NAVSEA SUPSAL
Crowley Marine (ships and installation crew)

Date: Jan 77 to June 78

Project Summary:

In January 1977, the Chesapeake Division, Naval Facilities Engineering Command (CHESNAVFACENGCOM) was tasked by the Public Works Center (PWC), San Diego to reinstall the sonar target *SQUAW*. *The SQUAW* is a 134.6 foot long 409-ton model experimental submarine hull which has been used by the U. S. Navy since 1959 as a sonar target in various locations off San Diego, California. The Squaw submarine mooring had failed three times since it was first moored in 1959 never lasting longer than five years.

The SQUAW was re-moored in 300 feet below the ocean surface in approximately 6240 feet of water at a location about 42 miles southwest of San Diego. It was installed on the last week of June 1978.

CHESNAVFACENGCOM provided the necessary engineering, the mooring analysis, the site survey, corrosion analysis, the ballasting experiment and analysis, equipment acquisition (including wire rope and equipment valued at over \$80,000 on loan from CHESNAVFACENGCOM's Ocean Construction Equipment Inventory), and overall Project Management. Through the Naval Sea Systems Command, *Supervisor of Salvage*, CHESNAVFACENGCOH contracted with Crowley Maritime Corporation to provide the vessels and personnel to perform the actual at-sea mooring installation. PWC, San Diego assisted with services to outfit the *SQUAW* and to provide and fabricate necessary mooring components.

THE SQUAW SUBMARINE

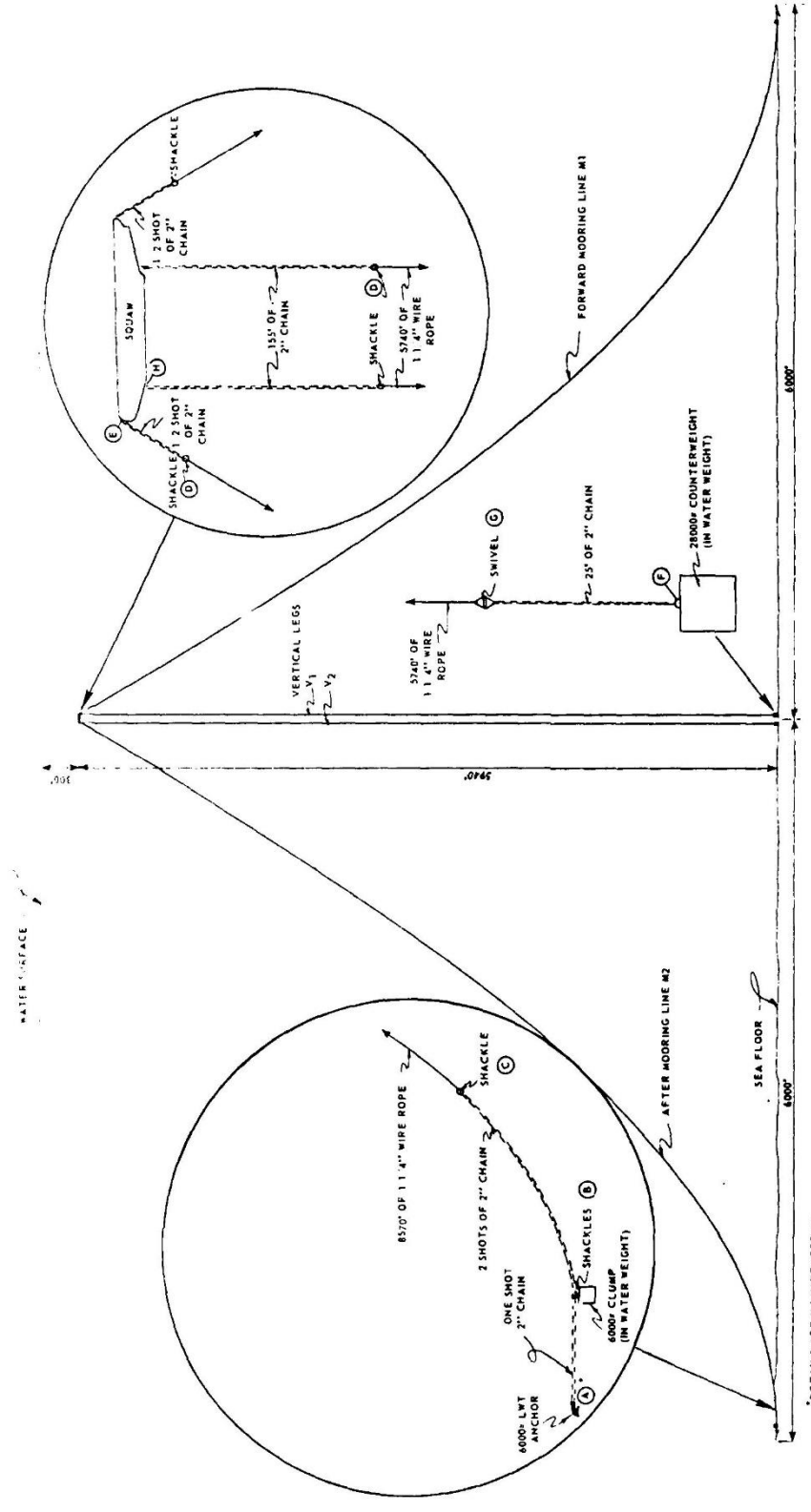
The *SQUAW* was refurbished at the U. S. Naval Shipyard, Long Beach, California in October 1976. The buoyancy and trim tests, and the *SQUAW* outfitting and preparation for re-mooring were carried out by PWC and CHESNAVFACENGCOM. These procedures required that the inner and outer structural hull hatch covers (bow and stern) be removed and replaced. These tests affected only the forward and after trim tanks and the external ballast tanks, and not the main pressure hull of the submarine. Air pressure tests were performed successfully on the bow and stern inner

hatch covers subsequent to each "closure". These tests and preparations, and all planning and outfitting for the *SQUAW* re-mooring were accomplished with the understanding that the interior hull is capable of withstanding the rigors of the tow out to the site, the installation, and the period for which it is expected to be submerged to a depth of possibly 300 feet.

MOORING SYSTEM

The SQUAW mooring system consisted of four legs aligned in one plane. Two legs are suspended vertically from the hull, each to its own clump or counterweight. These counterweights resist the major part of the vessels reserve buoyancy and hold the *SQUAW* at a submerged depth of 300 feet. Two additional mooring legs are included to resist fore and aft excursions. These legs form catenaries and also add to the vertical force opposed by the vessel's reserve buoyancy. Anchor spread was on the order of two nautical miles. The mooring was designed with a projected life in excess of five years. A substantial effort in the design was made to optimize the installation to preclude overstressing components before the mooring is set. The environmental loadings on the system are highly predictable in that the *SQUAW* is submerged 300 feet. Significant safety factors over the submerged conditions were included. The highest stresses occur during the installation phase; hence the greatest effort was made to optimize this installation. The various legs were installed separately with no interdependence during installation. The mooring system life is dependent on proper distribution of loads which is a function of moor geometry. The installation included both underwater navigation and leg tension measurement to ensure that the moor was installed as close as practical to the planned geometry.

Project Report Link: [ADA 163348](#)



DETAILS ARE ILLUSTRATED IN FIGURES 3-2B AND 3-2C

SQUAW MOOR COMPONENTS
FIGURE 3-2A