NAVAL MAGAZINE (NAVMAG) LUALUALEI, WEST LOCH BRANCH, QUALITY EVALUATION LABORATORY-ADMINISTRATION BUILDING
(Mine Mechanism Test Building)
(Building No. 40)
U.S. Naval Base, Pearl Harbor
D Avenue near Third St. intersection
Pearl Harbor
Honolulu County
Hawaii

HABS No. HI-206

HABS
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2-PEHA,
108-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN BUILDINGS SURVEY
National Park Service
Western Region
Department of the Interior
San Francisco, CA 94107

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HISTORIC AMERICAN BUILDINGS SURVEY

HABS No. HI-206

NAVAL MAGAZINE (NAVMAG) LUALUALEI, WEST LOCH BRANCH, QUALITY EVALUATION LABORATORY-ADMINISTRATION BUILDING

(Naval Magazine Lualualei, West Loch Branch, Mine Mechanism Test Building)
(Naval Magazine Lualualei, West Loch Branch, Building No. 40)

Location: D Avenue near the intersection with 3rd Street, NAVMAG West Loch, Pearl Harbor, Hawaii.

Significance: This building serves as an excellent example of military construction from the 1940s, and is significant as part of the WWII buildup of the base.

Description: The single-story wood-frame building is rectangular in plan, and has a concrete floor slab. At portions of the east and south sides the exterior wall is stepped back, creating an open covered-storage area. The east end also has and enclosed area with a partial-height wall and screens above. The wood-frame roof is gabled, with asphalt-shingle roofing and a monitor roof vent. The rafters have rounded ends. Windows are wood awning. The exterior siding is horizontal shiplap. See HABS No. HI-265 for additional description of the base.

History: This building was constructed in 1942, and originally served as the Mine Mechanism Test Building. A shed roof addition has been constructed on the north side, and some of the windows have been covered up. See HABS No. HI-265 for additional history of the base.

Sources:

Allan, Gwenfread
1950 *Hawaii's War Years*. University of Hawaii Press, Honolulu, Hawaii.

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1985 *United States Navy and Marine Corps Bases, Domestic*. Greenwood Press, Westport, Connecticut.

Honolulu Star Bulletin
1931 Munitions Work Contract Here Gets Increase. *Honolulu Star Bulletin*, July 2, 1931, pg.1, c.7.

1931 Munitions Job in Full Swing by October 1st. *Honolulu Star Bulletin*, July 24, 1931, pg.1, c.5.

1931 Island Labor for Lualualei. *Honolulu Star Bulletin*, , Aug. 3, 1931, pg.4, c.2.

Historian: Katharine Bouthillier, Spencer Mason Architects, 1994.

U.S. NAVAL BASE, PEARL HARBOR, MINE SCHOOL BUILDING
(U.S. Naval Base, Pearl Harbor, Naval Magazine Lualualei, West Loch Branch, Mine Mechanism Test Building)
(Quality Evaluation Lab, Facility 40)
D Avenue, near the intersection of 3rd Street
Pearl Harbor
Honolulu County
Hawaii

HABS No. HI-206

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ADDENDUM TO
U.S. NAVAL BASE, PEARL HARBOR, MINE MECHANISM TESTING BUILDING
(U.S. Naval Base, Pearl Harbor, Naval Magazine Lualualei, West Loch Branch)
(Quality Evaluation Lab, Building 40)
D Avenue, near the intersection of 3rd Street
Pearl Harbor
Honolulu County
Hawaii

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Buildings Survey
National Park Service
Department of the Interior
Oakland, California

ADDENDUM TO
U.S. NAVAL BASE, PEARL HARBOR, MINE MECHANISM TEST BUILDING
(U.S. Naval Base, Pearl Harbor, Naval Magazine Lualualei, West Loch Branch)
(Quality Evaluation Lab, Building 40)

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HISTORIC AMERICAN BUILDINGS SURVEY

U.S. NAVAL BASE, PEARL HARBOR, MINE SCHOOL BUILDING
(Facility 40)

This report is an addendum to a one page report that has been previously transmitted to the Library of Congress.

The Record Name of this facility reflects the historic name and not the name by which it was known when first recorded. This facility was referred to as a Mine School from the time it was built in 1942 until at least 1948.

Location: D Avenue near the intersection with 3rd Street
Pearl Harbor Naval Magazine, West Loch
City and County of Honolulu, Hawai'i
U.S.G.S. Pearl Harbor, HI Quadrangle 1999 (7.5 minute series) NAD83.
Universal Transverse Mercator Coordinates: 04.603900.2361250.

Present Owner: United States Navy
Present Occupant: Vacant
Present Use: Vacant

Significance: Facility 40 is located within the Pearl Harbor National Historic Landmark and is a contributing element. It is significant for its association with the history of the Naval Magazine at West Loch and the expansion of facilities at Pearl Harbor during World War II and for its association with the conduct of naval mine operations in the Pacific.

Report Written By: Don Hibbard
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119 Merchant Street, Suite 501
Honolulu, HI 96813

Historical Context by Dee Ruzicka

Date of Report: October 2009

PART I. DESCRIPTION

Facility 40 is situated adjacent to a railroad track on D Avenue, near 3rd Street. It is a single story, wood-frame building that follows a rectangular plan and is capped with a lateral running, composition-shingled gable roof with a monitor roof vent. The moderately pitched, four over twelve roof is supported by trussed rafters with exposed tails, spaced 1'-4" on center and has overhanging eaves, extending about 4' beyond the plane of the wall. The gable roof extends about 5' beyond the end of the building on the west end and its lateral running exposed 2" x 10" purlin tails are protected by a fascia.

The approximately 50' x 225' building sits on a 6" thick concrete slab foundation and is fourteen bays long, with each bay demarcated by a trussed rafter tail. The building features an inset lanai on its primary, southeast facing elevation, with five bays to the left of the lanai and originally two bays to the right, resulting in an asymmetric façade. The end bay on the right, which was a partially enclosed lanai, has collapsed during the past fifteen years, since its initial HABS photo documentation (see photograph HABS HI-206-2). All windows throughout the building are single pane awning.

The southeast elevation's lanai is 110'-8" long and 12'-0" wide, and has six 8" x 8" posts, which are about 10' high and sit on 1'-6" high concrete footing, supporting the 6" x 8" wall plate below each trussed rafter tail. The lanai has a plywood ceiling and its rear wall is of shiplap, which rises from a 3'-0" high poured in place concrete wall. The top 1'-6' of the wall is open, screened with expanded metal. The southern-most bay under the lanai contains an 11'-0" high x 12'-0" wide single sliding door, which provides access to the building. The original door has been replaced by a more recent plywood one. At the eastern end of the lanai, a similar doorway retains an original multi-panel door that has three horizontal rows of panels, four square panels in each of the top two rows and two rectangular panels in the bottom row. This door provides access to the eastern most extant bay of the building.

The shiplap clad wall of the five bays to the right of the lanai sits on a 2'-0" high poured-in-place concrete base. The bay at the corner of the building contains four sets of double stacked awning windows, while the third, fourth and fifth bays feature four sets of triple stacked awning windows. The latter three bays have a pair of wood slat ventilators centered below the windows. Initially the second bay from the end of the building featured fenestration similar to bays three, four and five, but it has been eliminated. The window sills in the first bay are 6'-10" above the ground, while those in the other bays are 4'-8" high. The solitary bay to the right of the lanai contains three sets of triple stacked awning windows, and the shiplap wall rises from a 3'-0" high concrete base.

The southwest end of the building has a shiplap wall which sits on a 2'-0" high concrete base. A doorway with a pair of hinged non-original doors is to the right of center. A simple, wood, shed roofed canopy protects the doors from the elements. To the left of the doorway are six sets of triple stacked awning windows. Wood slat ventilators are located below the windows at each end of this bank of windows. The windows are boarded up. A wood ladder, which was originally attached to the wall at the left end of this elevation is no longer extant; however, the square hole in the eave, allowing access to the roof, remains.

The northwest side of the building is obscured today by dense vegetation. As with the rest of the building this side has shiplap siding. The siding rises from a 2'-0" high reinforced concrete base, except at the eastern-most bay where the concrete base is 3'-0" high. With the exception of the two western-most bays, each bay on this elevation contains four sets of triple stacked

awning windows. Centered below the windows is a pair of wood slat vents. Almost all of the windows on this side of the building have been boarded shut. Two additions have been built on this side of the building. Off the fifth bay from the west end of the building is a shed roofed addition with corrugated metal walls. This addition housed the building's electrical and ventilation equipment. A four panel door with its bottom panel having a wood slat ventilator is in the addition's west wall. Wood slat ventilators also frame the corrugated wall at both the top and bottom.

The second addition is at the north end of the northwest wall. Used as a storage battery charging shop, this addition has a low pitched, lean-to like, corrugated metal shed roof and open sides. Two rows of four 4" x 6" posts run parallel to each other and support the roof. The posts are approximately 8' high and support 2" x 12" beams that run the length of the addition, while 2" x 12" purlins run through the beams.

The floor plan for the interior of the building has been modified to accommodate different functions over time. The roof structure is exposed throughout the building, and is comprised of Pratt trusses with 4" x 6" kingposts, steel tie rods, and sub diagonals. The bottom of the 8" x 8" bottom chord of the truss is about 12' above the floor. Paired, 2" x 4" braces extending upward from the walls' 8" x 8" structural posts at the truss points provide additional structural stability, as do the 2" x 10" joist bracing that run between the trusses' bottom chords. The roof purlins measure 3" x 10" and rest on the trusses' top chords.

The partitioning of the interior spaces has changed somewhat since the building was originally constructed as a mine school. To the left of the south side's sliding door entry was an area originally devoted to a locker room, classroom and offices. Much of the original spatial configuration of this area is readily recognizable with the partition walls sitting on concrete curbs. A lateral running hallway bisected the area, with the toilets and a locker room on the south side, and the classroom, offices, and an armory on the north. The mens and officers toilets remain, although now they serve as men's and women's toilets. Some original fixtures, including sinks, remain intact. The locker room and showers no longer exist, their walls have been removed to form a large room with the hallway. Similarly, on the north side of the hallway the walls defining the classroom and offices have been removed to form one space. The former armory, which straddled the fifth and sixth bays from the west end of the building, still remains as a long thin room.

Much of the area to the right of the south entry has been altered. A lateral running, central corridor extended the length of the building on this side. Drawings indicate that on the south side of the corridor were a series of cages enclosed by expanded steel mesh secured to 2" x 4" frames. Now only one cage remains, standing in the eighth and ninth bays from the west end of the building. On the north side of the corridor was a series of seven partitioned work areas which housed various mine preparation facilities. This side has been reworked with the original partitioning removed. Bays seven through eleven have been enclosed to form a large room, with two small offices at its west end. In the eighth bay from the west end, one set of windows has been removed and replaced with a hinged door. Between the twelfth and thirteenth bays a shiplap wall, sitting on a 3'-0" high reinforced concrete base separated the thirteenth bay from the remainder of the interior space to form a room that ran the width of the building. A centered 9' x 12' flat arched opening in the wall allowed ingress and egress. A similar wall separated the thirteenth and fourteenth bays and holds a centered set of sliding double doors that led out to the final, partially enclosed, now collapsed end bay for the building. Three sets of triple stacked

awning windows are to the north of the doorway and looked out on the more open end of the final bay.

A small wooden crane is located near the railway tracks at the north corner of the building, and was used to load the mines on the trains.

PART II. HISTORICAL CONTEXT

For a detailed account of West Loch Branch of Naval Magazine Lualualei during the Cold War, See Addendum to HABS HI-161, U.S. Naval Base, Pearl Harbor, Naval Ammunition Depot West Loch, Dispensary, Facility 43.

Facility 40, Construction Contract History and Early Use

Facility 40 was constructed under contract NOy-4173 by Contractor's Pacific Naval Air Bases (CPNAB), a consortium of firms doing construction work for the Navy in the Pacific during the period before WWII and during the early war years. Facility 40 was Project Number 676 under that contract.[1] CPNAB completed their work at West Loch on July 1, 1943 when Navy Construction Battalions (CBs, or Sea Bees) took over.[2]

Original plans for Facility 40 were produced by the Fourteenth Naval District. Most of the surviving original plans that are dated May and August 1942 are signed V.O. as the architect/ engineer. This architect was Jozef Van Oort, who was the chief architect at Pearl Harbor from 1939 until his retirement in 1958. Mr. Van Oort was born in Zwolle, Holland about 1893 and received his architectural degree in that country, before moving to the United States in 1923. He lived in California and did architectural work for the U.S. Government in the early 1930s before being hired in 1935 by the U.S. Army Air Corps to relocate to Hawaii and work on the design of Hickam Field. After completion of Hickam in 1939 he worked for the U.S. Army Corps of Engineers for a short while and then went to work for the Navy. He was in charge of all architectural operations at Pearl Harbor during WW II and the Korean War. The original plans initialed by Mr. Van Oort were drawn by one of two draftsmen with the initials G.H.J. or P.C.S. The project manager, as indicated on the drawings and in the contract records of CPNAB, was Robert M. Belt. Belt was a civil engineer who would go on to become a co-founder of the prominent Hawaii planning and engineering firm, Belt Collins Hawaii, Ltd.

Facility 40 was built as a Mine School Building, completed in October 1942.[3] The building's interior was partitioned into a number of spaces and rooms that were designated for working on the various parts of the Mk 6 (Mark VI) naval mine, the most commonly deployed naval mine of World War II. Other rooms enabled its use as a school building. Rooms included; lecture room, locker room, model room, tool room, armory, machine shop, K preparation, K3 shallow deep, battery plugs-hornes[sic]-wires preparation, batteries, floats, float wind., extenders, extender preparation, releases & plummet spools, release preparation, straps-turnbuckles, misc. work, anchors & plummet winding, and welding shop. There were also two outdoor areas covered by the building's roof that were designated as outside work area, and anchor overhaul – plummet &

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[1] Contractors Pacific Naval Air Bases (CPNAB), *Technical Report and Project History Contracts NOy 3550 and NOy 4173*, Microfilm of report Pacific Division Naval Facilities Engineering Command Library. N.d., A-272.
[2] (CPNAB), *Technical Report*, A-275.
[3] (CPNAB), *Technical Report,* A-272.

anchor wind. The building also contained an office, toilets, a shower and a wash area, a first aid room, duty officer's room, and a watch stander's room.[4]

During WW II naval mines were loaded and filled (with explosive) at the Naval Ammunition Depots at Yorktown, VA and Hawthorne, NV. Final assembly would have taken place at depots closer to the combat areas, such as West Loch where mines would have prepared for deployment and loaded onto vessels for laying or for transport to combat areas. This assembly and preparation would have included inserting detonating devices (extenders), attaching plummet weights (used to determine the depth below the surface that the deployed mine would be moored at) and anchors, and winding and setting mooring and plummet cables. West Loch was expanded during the build up to WW II and the early war years to include; magazines for high explosives, magazines for assembled mines, magazines for fuses and detonators, and magazines for torpedoes. Other buildings were constructed to store mine anchors, fixed ammunition, projectiles, pyrotechnics, and inert material.[5]

Facility 40 remained a mine school to at least 1948. By 1951 Facility 40 was being referred to as a Mine Mechanism Test Building.[6] A ca. 1954 drawing showing repairs and alterations to Facility 40 describes it as a "Mine Overhaul Building" in the title block.[7]

In 1995 Facility 40 was being used for; public works maintenance storage, administration offices, depth charge rework, and quality evaluation lab.[8] The Quality Evaluation Laboratory Department of the Naval Ammunition Depot at Lualualei/ West Loch was part of the Naval Air Systems Command (NAVAIR), and responsible for supporting naval aircraft weapons and other airborne weapons, such a as missiles. NAVAIR is the 1966 successor to the Bureau of Naval Weapons (BuWeps) which was formed in 1959 by the merger of the Bureau of Aeronautics and the Bureau of Ordnance to take responsibility for procurement and support of naval aircraft and aerial weapons. When it was under BuWeps, the Quality Evaluation Laboratory (under its Director H. H. Meeker, Jr.) was:

> to determine and report the quality of the Navy's stockpile of ammunition and weapon systems. The Oahu [West Loch] laboratory [was] responsible for Navy-wide coordination and summarization of quality information derived from testing many advanced and complex weapons. The work involves design and development of test equipment which simulates operational environments, testing samples of Pacific stocks, analysis of data and preparation of reports which tell the Bureau and the Fleet what level of performance can be expected in case of war. A Type II Standards Laboratory [was] operated by the Laboratory [at West Loch], providing the highest level Navy Calibration service outside the continental United States.[9]

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[4] Naval Facilities Engineering Command (NAVFAC) Pacific Division, Plan files drawing numbered OA-N4-783, May 4, 1942.

[5] Department of the Navy, Bureau of yards & Docks, *Building the Navy's Bases in World War II: History of the Bureau of Yards and Docks and the Civil Engineer Corps, 1940-1946, Vol. I & II,* (Washington D.C.: Department of the Navy, 1947), Vol. II, 146.

[6] NAVFAC Plan files drawings numbered OA-N1-1673, June 30, 1948, and OA-N1-2210, June 30, 1951.

[7] NAVFAC Plan files drawing numbered 516258, ca. 1954.

[8] "Detailed Inventory of Naval Shore Facilities P-164, Magazine Lualualei," (Pearl Harbor: NAVFAC Hawaii, September 30, 1995), 59-61.

[9] "Organization of NAD Oahu," *Oahu Detonator*, news flyer of NAD West Loch, Waikele, Lualualei, May 1964, 3.

Naval Mines in World War II

Although naval mines had been used for many decades previously, their successful application during the Russo-Japanese War (1904-05) prompted the U.S. military to begin to recognize their potential. Initially relying on French and British designs, the U.S. subsequently developed the Mk 5 and Mk 6 mines for use during World War I. Both of these mines were independent, contact type, moored mines. The Mk 6 was extensively utilized in WW II and remained in service until at least 1979.

Naval mines are classified using a number of categories. The two broadest classifications are:

> **Independent** mines are those that are planted and armed to explode without further human intervention.
>
> **Controlled** mines have an electrical system connected to a shore station which can detonate them on command. Controlled mines were the type used for American harbor defense (including Pearl Harbor) by U.S. Coast Artillery Corps.

Mines are also classed by the firing type:

> **Contact** mines are detonated when a ship actually touches it or one of its initiating components.
>
> **Influence** mines are detonated when a ship passes near enough to the mine for its sensing mechanism to detect it and trigger the explosion. Sensing mechanisms can be receptive to **magnetic**, **acoustic**, **pressure signals**, or a combination of these signals.

Mines are also classified by their position after planting:

> **Moored** mines have their explosive charge in a buoyant case that is attached by a cable to an anchor on the sea bottom.
>
> **Bottom, or Ground** mines rest on the sea floor.
>
> **Drifting** mines float freely.

Mines are further classified by their method of planting:

> They can be laid from **surface vessels**, **submarines**, or **aircraft**.

Besides being armed for detonating upon the first ship that triggers it, an independent mine can be set up with different initiating (arming) delays. The mine might be equipped with a clock timer which will allow the mine to remain unarmed for a considerable time after it is planted. Or a mine could have a ship counter to let numerous vessels pass before arming and detonating on a later ship. Arming delays can have a very unsettling effect on an enemy force when they believe that there are no longer any mines in the area.

Throughout the first half of the twentieth century, controlled mines were a primary means of harbor defense. Controlled buoyant mines were used by the U.S. Army Coast Artillery Corps until about 1943 to defend American (and Territorial) harbors. Mines were generally held ready onshore for immediate use to be planted in groups at the harbor mouth when situations dictated. The Army maintained a fleet of mine planting vessels until about 1947 when coast artillery commands were disbanded and all mining was transferred to Navy units. During WW II mines were typically laid in groups of nineteen mines, each mine spaced about 100' apart. Each of the mines in these groups, called "grand" groups, had a control cable leading to a submerged distribution box. From there a single cable lead to an onshore mine casemate structure where

an operator fired the mines. These mines could be fired by several methods; activating them on contact with a vessel and then firing after a short delay in order to get the mine under the center of the ship, or they could be manually fired by an observer on shore after tracking the target, or they could be set to fire on contact with a ship.

An early development which enabled contact mines to function reliably was the Hertz horn, a spiked projection on the mine that would trigger its explosion when the horn was crushed by contact with a ship. The Hertz horn is a hollow lead (or other soft metal) tube, sealed at its outer end and fixed to the mine. At the inner end of the horn are the dry metal plates of a storage battery and inside the horn is a glass vial of electrolyte solution. When the soft metal horn is crushed by a ship's hull, the vial is broken and the electrolyte drenches and energizes the metal battery plates creating an electric current which detonates the mine. This system has proven very durable, with no switch to corrode and no charged battery to run down. The Mk 5 U.S. Naval mine employed Hertz horns to trigger detonation. In addition to Hertz horns, the Mk 6 mine employed a copper antenna system which triggered the mine to explode when it was touched. This antenna system, termed a K-device or "K-pistol,"[10] reached upward toward the surface of the ocean from the mine which was moored below. This had the effect of increasing the area that each mine could effectively cover, extending up vertically through the water column from the mine, a useful feature against enemy submarines. The K device operated by attaching its copper antenna to copper plates on the outside of the mine. The seawater which bathed the copper plates functioned as battery electrolyte solution, and when the steel hull of a ship touched the copper antenna, an electrical charge was generated through the galvanic action between the two dissimilar metals. This electric pulse fired the mine. As a safety device when laying the Mk 6 mine, a soluble washer was used between the copper plates of the K-pistol. While the washer was in place it prevented the galvanic action from firing the mine if the K-pistol was contacted by a steel ship hull. Varying compositions were used for the washers which dissolved from as little as five minutes to as long as six hours to provide varying amounts of time for the mine laying vessels to operate safely within the minefield before the mines were armed.

The development of influence mines during WW II followed an interesting evolution between the Allies and the Axis powers. Germany began using magnetic mines in 1939, initially planted by submarine. Great Britain countered by utilizing minesweepers designed for moored contact mines with poor results, and ships kept exploding in the swept areas. Suspecting magnetic (bottom) mines, the British could not devise a countermeasure until a mine was captured. When Germany began laying the magnetic mines by aircraft, in November 1939, the British made the connection between the low, night flying aircraft and their exploding ships. Then one mine was inadvertently dropped on the mudflats of an estuary of the Thames River by the Germans, and recovered and analyzed by the British. New sweeping techniques were developed using towed cables that were electrically energized to simulate the hull of a ship, thus exploding the magnetic mine. Also in 1940 the United States (and Great Britain) began degaussing and deperming their vessels, reducing the magnetic field of a ship to allow it to operate in unswept areas.

To degauss a ship it was equipped with cables wound horizontally about the hull. When electrically energized, the cables turned the ship into an electromagnet which could defeat a magnetic mine in two different ways; if the induced magnetic field was intensified it was possible

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[10] Tony DiGiulian, *United States of America Mines*, 2008..Website www.navweaps.com/Weapons/WAMUS_Mines.htm Accessed on August 27, 2009, 2.

to detonate magnetic mines far enough from the ship to cause no damage. A less powerful field could be tailored to neutralize the ships normal magnetic signature and cause it to not register on the sensors of a magnetic mine. In order for this induced field to be properly calibrated, the natural magnetic signature of a vessel needed first to be measured. This was done at degaussing (fluxmeter) ranges, which were wire coils placed along the bottom of a channel that recorded the magnetic signature of a ship passing over them. Each ship's signature was different depending on its size, shape, and construction. Once determined, the normal magnetic signature could be cancelled when required by an exact and measured application of electricity through the degaussing cables. Because the magnetic signature of a ship changed it was necessary to run each vessel over a degaussing range periodically to ascertain its current magnetic value. To keep up with a rapidly moving combat line, mobile degaussing units (ranges) were fielded by the U.S. in late 1942.

Deperming was also carried out to minimize the hazard of magnetic mines. This consisted of removing the permanent, residual magnetism of a steel hull that was acquired during its construction. Deperming was an operation that was undertaken periodically on the vessel, its effects could last up to a year, reducing the residual magnetism of a ship hull. Used in conjunction with degaussing, which reduced a hulls induced magnetism, deperming made degaussing easier and cheaper. Deperming was accomplished by winding the ship with a solenoid coil in ten to twenty vertical planes perpendicular to her main axis. When electrically energized with alternating directions of decreasing magnitude charges, beginning with several thousand amps from a high capacity storage battery system, the permanent magnetism of the hull was neutralized temporarily, usually for a period of months.

Shortly after the U.S. and the British began degaussing and deperming, Germany began deploying acoustic mines, in August 1940. This type of mine is triggered by the sounds of a nearby ship, either its engine or propellers. Later acoustic mines could be triggered by a ship's sonar. By October, the Allies had recovered a German acoustic mine and quickly developed a simple countermeasure. Vibrating hammers were employed on Allied vessels which acted as an intense noise-making device. These were adjusted to operate at the correct pitch to trigger acoustic mines far enough from the vessel to avoid any damage.

During the early years of WW II both Germany and the U.S. developed reliable pressure-triggered mines. These mines are sensitive to the drop in water pressure that occurs when a large ship passes above it. They are generally bottom mines in relatively shallow water and have a device which prevents them being triggered by ocean swells, usually dependent on a very rapid pressure change for initiation and often coupled with a magnetic detection system. Curiously, although both U.S. and German navies had this type of mine, neither deployed it until relatively late in the war, both fearing that it would be recovered by the enemy and its secrets revealed. A pressure sensitive mine coupled with a magnetic detection system is generally considered to be un-sweepable.

Mines can be fitted with other devices such as anti-countermeasure systems that will prevent the mine from firing as a result of a nearby explosion. This reduces the chance of an exploding neighboring mine triggering a run of sympathetic detonations. Another device often employed is a sterilizing mechanism which disables an armed mine after a period of time. This would be used when a minefield must be deactivated to allow for a pre planned invasion. These devices commonly operate by opening the detonating circuit. They can be controlled by a clock timer, but often when a more positive method is needed they are set up with an electrolytic cell and a spring loaded switch. As current passes through the cell, the anode is eroded until it gives way

and allows the spring-loaded switch to open. Two or more sterilizers can be used on each mine to ensure positive neutralization of a mine field.

The Navy Mk 6 mine, developed in 1916-17, featured several advancements in naval mine design that would help to keep it in service for many decades; it was easy to load, fairly safe to handle, had an antenna which significantly increased its effective contact area, and it was mass produced. Previous mines were subject to a complicated assembly (loading) process whereby the explosive charge was loaded in to a container which was then placed in to the mine casing. This older process used a heavy (explosive) container and also resulted in a dead air space in the loaded mine which deadened its destructive power. The Mk 6 mine was produced by pouring trinitrotoluol (TNT) explosive directly into the case, where it hardened. This process eliminated the heavy container and air space of the older design.

Operational deployment of the Mk 6 mine occurs in several steps that are designed to suspend the moored mine at a specific (preset) distance below the surface of the ocean in waters of varying depth. When the mine is launched from a surface ship, its two main components, case (carrying the explosive charge) and anchor are joined together and the assembly floats for several seconds as the anchor floods. During this time a weight, called a plummet, which is attached to the anchor by a cable, separates from the anchor and drops to the end of its cable. The length of this plummet cable is preset to the same length as the required depth below the surface that the mine case is to be moored. The tug of the plummet reaching the end of its cable releases a mechanism which separates the anchor from the floating case, and the flooded anchor sinks. As the anchor drops, another cable that attaches it to the floating case pays out from a drum within the anchor. The anchor sinks to the ocean floor with the plummet still suspended a specified distance beneath it, all the while paying out cable from the drum to the floating case above. When the plummet strikes the ocean bottom, it triggers another mechanism which locks the cable drum. The anchor continues to sink, attached to the floating case by the cable which is now locked and no longer paying out. The sinking anchor pulls the case down below the surface until the anchor comes to rest on the bottom. As the case is pulled down a float separates from it that raises the copper antenna upward into position in the water above the case.

Mk 6 mines deployed from surface ships were launched in one of two methods. In the first, tracks were mounted on the planting vessel, and the mines, equipped with corresponding rollers, were wheeled along the tracks and off the side or rear of the vessel. In the second method, the mines were maneuvered overboard using an over side crane. Because this widely used mine was easy to plant, not requiring specialized vessels, there was only one dedicated minelayer built during WW II, the USS *Terror*. The Mk 6 mine was commonly deployed from small coastal minelayers that were converted from other types of vessels, often fishing trawlers which were typically equipped with cranes.

Facility 40 had areas designated for K-devices, plummets, floats, (Hertz) horns, anchors, and extenders during the time it was designated a mine school, a mine mechanism test building, and a mine overhaul building. The extender, another mine component prepared in Facility 40, is a device which is a part of the detonating system. Before the mine is deployed the extender acts as a safety to prevent accidental detonation of the mine in storage or transit. It does this by physically holding the detonator away from the booster charge until the mine is under water. The extender is actuated by water pressure when the mine is submersed to a specified depth. The water pressure acts on a diaphragm to trigger a spring-loaded mechanism that moves the detonator into the explosive booster when the mine is submersed.

Naval Mine Warfare in the Pacific During World War II

On the evening of March 3, 1942, two Japanese aircraft, Kawanishi H8K "Emily" flying boats, landed in the sea near French Frigate Shoals in the Northwest Hawaiian Islands to refuel from Japanese submarines after flying from Wotje Atoll in the Marshall Islands, a distance of about 1,900 miles. The flying boats were en route to attack Pearl Harbor, Oahu. Each Emily carried four 500 pound bombs. While twenty mile-per hour winds raised five foot seas, the flying boats took on aviation fuel from the submarines before taking off for Oahu at about 9:38 pm. Cloud cover obscured Oahu as the two flying boats approached at 15,000 feet. Around 2:10 am, thinking he caught a glimpse of Ford Island through a break in the clouds, one aviator turned sharply and dropped his four bombs. He was mistaken about his target and the bombs exploded on the side of Tantalus Hill about six miles east of Pearl Harbor. The other aircraft continued south, dropping bombs at sea before both aircraft flew west to their base in the Marshall Islands.

Although initially suspecting that the bombing attack was mounted from Japanese submarines that had been designed to carry aircraft, or from surface carriers, the U.S. Navy soon realized how the attack was structured and ordered the naval mining of French Frigate Shoals to preclude its future use as a refueling rendezvous for Japanese submarines and aircraft. Mine Division One was dispatched from West Loch to lay mines there. On March 30, 1942 the USS *Pruitt*, *Preble*, *Tracy*, and *Sicard* laid a minefield west of La Peruse Rock at French Frigate Shoals. Returning twice to West Loch for more mines, the ships returned on April 3 and April 8 and laid additional minefields to the north and south of the first.[11] Although the mines used at French Frigate Shoals were likely Mk 6 mines, the minefields were planted before Facility 40 was completed.

The United States had over 23,000 Mk 6 mines ready for deployment in mid-1941, and an additional 35,000 of these mines on order.[12] Although the Mk 6 mine was used in large numbers during WW II it was not likely to have been deployed in areas that were in extremely close proximity to the front lines. This is because newer, influence mines had been developed that were more suitable to be planted by submarine and aircraft, methods that posed much less hazard to the crews when operating under potential enemy fire. The Mk6 mines were more apt to have been utilized along shipping lanes and harbors where the enemy had been somewhat neutralized and a larger minefield of less expensive ordnance could be successfully utilized.

Between the time that the first U.S. mines were planted at Corrigidor on July 15, 1941 and the last were air dropped near Japan on August 14, 1945, about 25,000 mines were planted in the Pacific theater. About 85 percent of these were laid by aircraft.

A notable use of naval mines planted by aircraft occurred on March 30 to April 1, 1944 when U.S. TBF Avenger torpedo bombers dropped Mk 12 mines (magnetic ground mine) into the entrance points to Palau Lagoon where about thirty two Japanese ships were berthed. The mines prevented the ships from sortieing out of the lagoon, making them easy targets for the Avengers that attacked with torpedoes. Twenty three ships were destroyed and the rest damaged with two U.S. aircraft lost. The mines used for this operation had been loaded on

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[11] Arnold S. Lott, Lt. Cmdr, USN, *Most Dangerous Sea*, (Annapolis, MD: U.S. Naval Institute, 1959), 30-31.
[12] Norman Youngblood, *The Development of Mine Warfare: A Most Murderous and Barbarous Conduct,* (Westport, CT: Praeger Security Interantional, 2006), 133.

board the USS *Terror* at West Loch Mine Depot which transported them to the aircraft carriers *Lexington, Bunker Hill*, and *Hornet* which mounted the attack on Palau.[13]

The most significant aircraft-delivered mining effort of the war was Operation Starvation, undertaken by B-29 bombers from the 313th Bombardment Wing of the Army Air Corps. Beginning in March 1945 this operation, running concurrently with the bombing of the Japanese home islands, was tasked with mining Japanese waters to disrupt the shipment of supplies. Operation Starvation parachute-dropped about 12,000 acoustic, magnetic, and pressure influence mines. These are types that are not thought to have been associated with Facility 40.

The Minelayer USS *Terror* in the Pacific and at Pearl Harbor During WW II

The USS *Terror* (CM-5) was the Navy's only vessel during WW II that was built specifically for minelaying. It was launched on June 6, 1941 and spent its time until October 1943 operating in the Atlantic during which time it participated in Operation Torch (the invasion of North Africa by the Allies), conducting and supporting mine laying operations, including the use of Mk 6 mines. A large ship (454' long) the *Terror* was built with tracks on its mine deck (just below the weather deck) which would allow the Mk 6 mines to be planted by rolling them out the openings at the rear of the vessel. It had additional mine storage space on the cargo deck below the mine deck.

In late October 1943 the *Terror* arrived at Pearl Harbor to begin several years of Pacific operations which included periodic returns to Pearl Harbor to replenish her mines and other supplies. While at Pearl Harbor, the *Terror* moored at West Loch and often took on magnetic mines.[14] On November 9, 1942 the *Terror* arrived at Funafuti, Tuvalu and spent the next several weeks there supporting small craft that were laying minefields at the atoll in preparation for the attack on Tarawa. She returned to Pearl Harbor (West Loch) in late November to load mines and departed for the Tarawa operation in December, again providing mines and equipment for minefields. In late December the *Terror* sailed to Espiritu Santo, Guadalcanal, and Makin Island where she mined channels through the reef using a self-propelled barge. Returning to Pearl Harbor in early February 1944 she then sailed to San Francisco, picked up about 500 passengers (probably troops) and transported them to Pearl Harbor. The passengers were accommodated on a temporary wooden deck built over the tracks on the mine deck.[15]

The *Terror* next arrived at Majuro on March 10, 1944 and for the rest of that month and most of April conducted mining details in the Marshall Islands before returning to Pearl Harbor for repairs and to load more mines and supplies. The following months were spent carrying mines, bombs, and ammunition about the Marshalls and the Marianas with one return to Pearl Harbor for resupply. After a brief drydock in San Francisco for repairs in August, she carried ammunition to Pearl Harbor before taking on a load of mines and sweeping equipment and departing for Ulithi on September 9 to lay defensive mines.

October and November 1944 saw the *Terror* carrying supplies to the Marianas, Carolines, and Admiralty Islands, and returning to Pearl Harbor for repairs and alterations in the Navy Yard on

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[13] Arnold S. Lott, *Most Dangerous Sea*, 172-173.

[14] Allie Ryan and David Mincey, "USS Terror: War Cruise of USS Terror, Her Officers and Men, 1942-1947," (Blue Hill, ME: A. Ryan, 2003), 8, available at www.openlibrary.org/b/OL3763407M/USS-Terror accessed on August 26, 2009.

[15] Department of the Navy, Naval History and Heritage Command, *Dictionary of American Naval Fighting Ships, USS Terror,* (Wash. D.C.: Navy Historical Center, 1991), avail. from www.history.navy.mil/danfs/t4/terror-iii.htm accessed on August 26, 2009.

November 25 before the vessel's assignment on January 6, 1945 as flagship of the Commander, Minecraft Pacific Fleet, RAdm. Alexander Sharp. In late January and early February the *Terror* transported mines and mining gear to Ulithi for the invasion of Iwo Jima and then sailed to Tinian to support mining activities there. She returned to Iwo Jima on February 17, 1945 for two days to support the invasion there, shelling the island with her five-inch guns and acting as a casualty evacuation vessel before returning to the Marianas. February 24th the *Terror* was at Kerama Retto near Okinawa to supply mine warfare vessels that were to participate in the invasion. Throughout April Kamikaze attacks were waged on the *Terror* and nearby ships and on May 1, 1945 she was struck. The magazines were flooded to prevent additional damage, but the *Terror* suffered 171 casualties, forty one dead. The *Terror* returned to Pearl Harbor and then on to San Francisco for repairs. The ship returned to action on August 15, sailing back to Okinawa as the war in the Pacific ended.[16]

U.S. Naval Mine Activity During the Cold War

During the Korean War (June 1950 to July 1953) the U.S. did not employ any naval mines, and was involved only with mine countermeasure and mine sweeping operations.[17]

United States use of naval mines in the Vietnam War did not occur until the late stages of the war with the mining of Haiphong Harbor. On May 8, 1972 Navy aircraft from the carrier USS *Coral Sea* laid Mk 52 mines along the entry to Haiphong Harbor in North Vietnam. These are 1000 lb ground mines which can be fired by acoustic, magnetic or combined pressure and magnetic and/ or acoustic triggers. In the ensuing months thousands of these were laid in North Vietnamese harbors along with Mk 36 Destructor mines, which are ground mines converted from Mk 82 500 lb bombs.[18] This mining campaign along with the U.S. Operation Linebacker bombing campaign are thought to have influenced the North Vietnamese to negotiate the Paris Peace Accords of 1973.

In early 1984 the Central Intelligence Agency had about seventy five mines of its own design laid in the Nicaraguan harbors of Corinto and El Bluff. These mines were specially designed to be non-lethal to ships, with low explosive power in order to generate splash effects. This was expected to prompt maritime insurers to increase rates or deny insurance to ships in order to slow Nicaraguan shipping and influence the government to act more favorably toward the United States. The mining was seen as escalating the situation and the U.S. Senate Intelligence Committee was discredited for having done nothing to prevent it.[19]

In January 1991, forty two mines were planted in the Persian Gulf by Navy A-6 aircraft with no noticeable effect on Iraqi ship movements there. One A-6 was shot down during the mine laying operation.

After the Mk6 mine was removed from active service, about 1985, it was relegated to use as a training tool for practice in mechanical sweeping techniques for moored mines. Actuators, extenders, and explosive charges were removed from the mine for this detail and the mine cases were painted orange and white.

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[16] Ibid.
[17] Sabrina R. Edlow, *U.S. Employment of Naval Mines: A Chronology*, (Alexandria, VA: Center for Naval Analysis, 1997), 1, 4.
[18] Edward J. Mardola, "U.S. Mining and Mine Clearance in North Vietnam," (Navy History & Heritage Command, April 2008), available at www.history.navy.mil/wars/vietnam/minenorviet.htm accessed on August 31, 2009.
[19] Edlow, *Employment of Naval Mines*, 8-10.

PART III. SOURCES OF INFORMATION

A. Architectural Drawings:

Historic drawings are available as electronic scans only, and can be viewed on the NAVFAC Pacific Plan File data base at Building 258, Makalapa, Pearl Harbor. Scans can be viewed and printed on 11" x 17" paper only.

B. Early Views:

Aerial photos are available in the aerial photo collection and the Admiral Furlong Collection at the Hawaii State Archives (HSA). The photos of the Admiral Furlong Collection were taken under the direction of Admiral William R. Furlong, Commandant of the Pearl Harbor Navy Yard. These photos were created by a U.S. federal agency (U.S. Navy) and are considered in the public domain.

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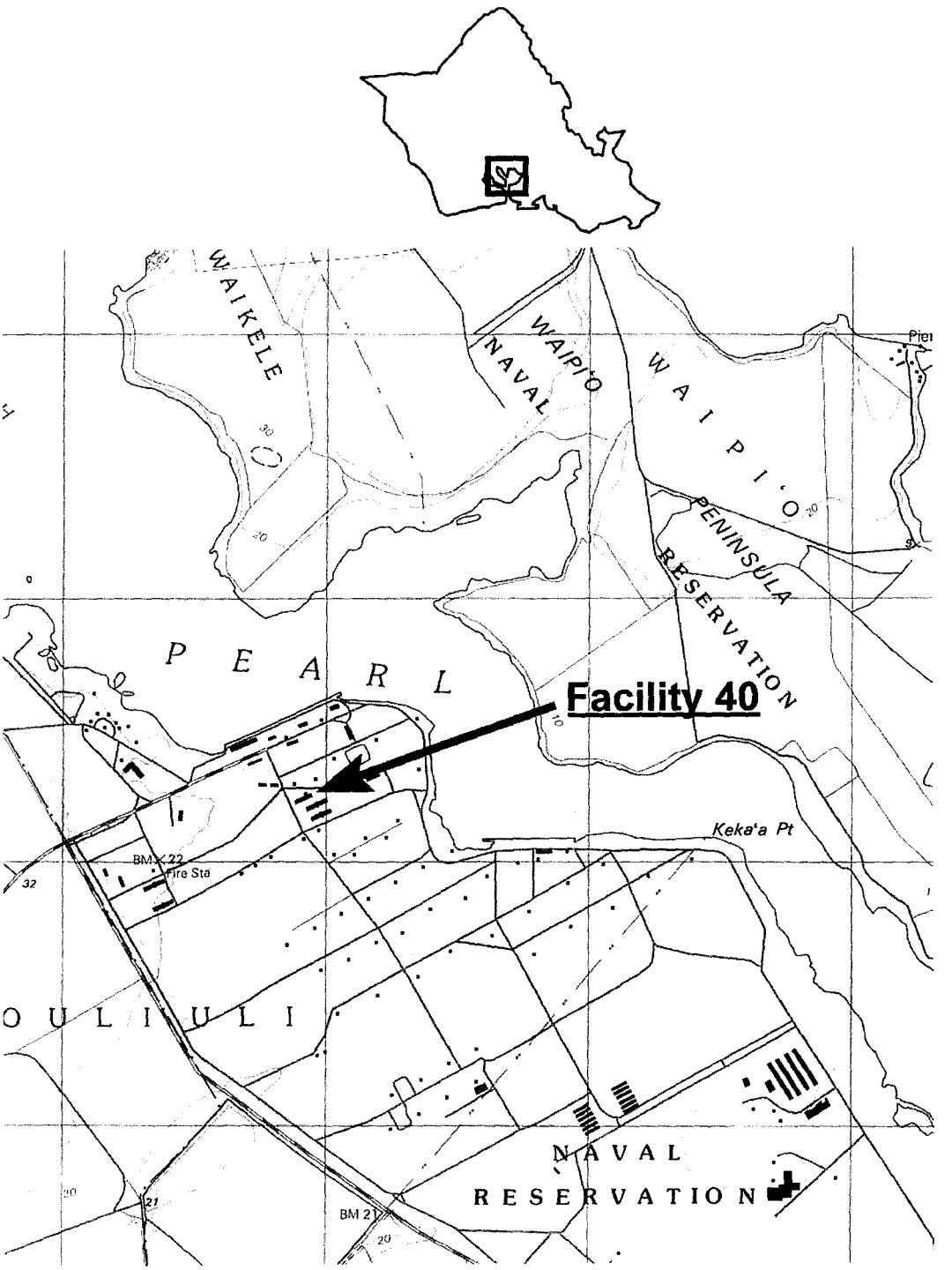
PART IV. PROJECT INFORMATION

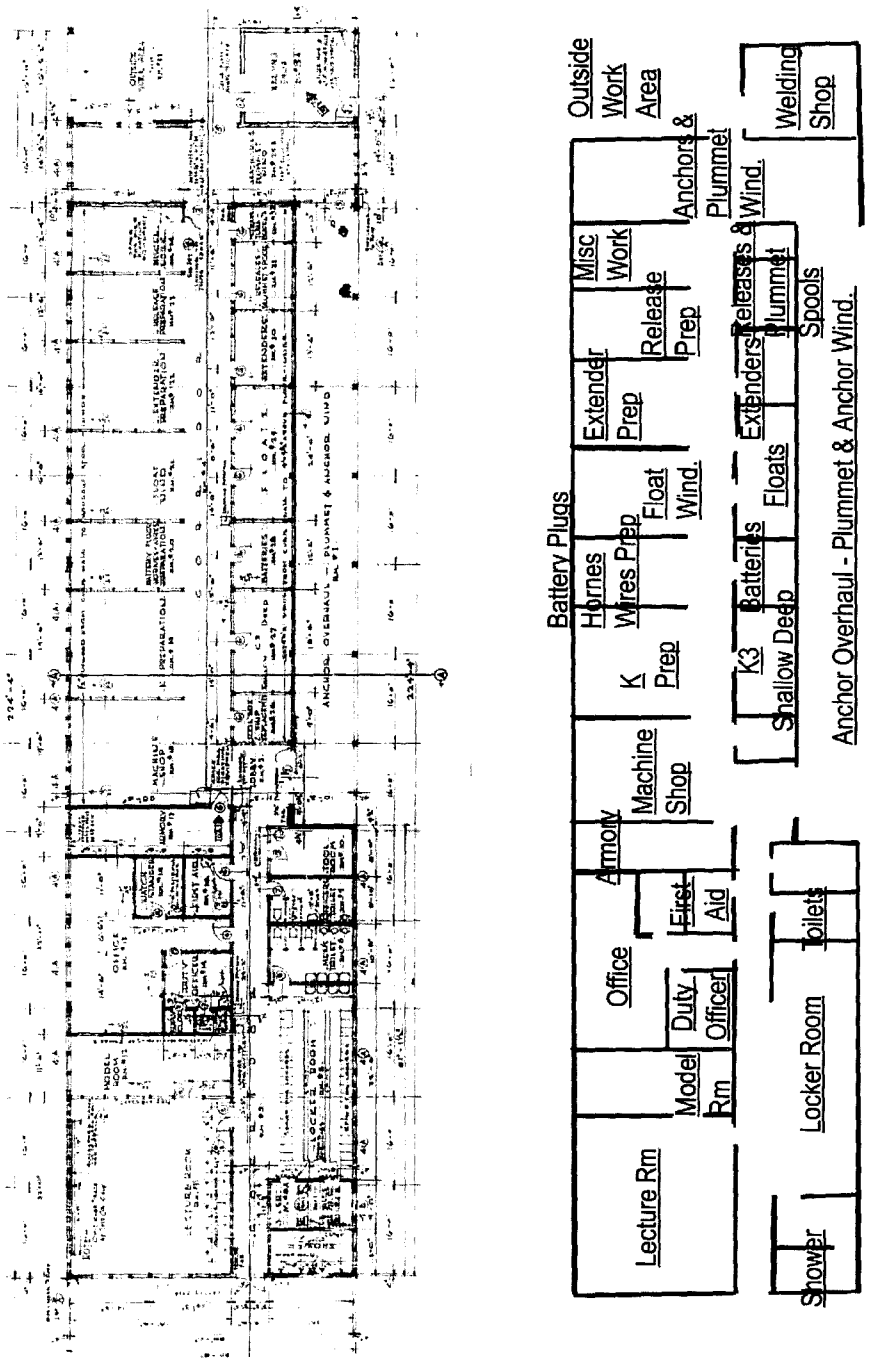
The demolition of Facility No. 40 as part of the CNIC Demolition Footprint Reduction Program has been proposed by the Navy. In accordance with 36 CFR Part 800, implementing regulations of Section 106, National Historic Preservation Act, Commander Navy Region (COMNAVREG) Hawaii has consulted with the Hawaii State Historic Preservation Officer (SHPO) and other consulting parties. This photo documentation and recordation is a partial fulfillment of the mitigations stipulated in the Memorandum of Agreement among COMNAVREG Hawaii and SHPO.

This report was prepared under a Historic Preservation Services contract (N62742-06-D-1869) awarded to Wil Chee Planning, Inc., the prime contractor, by the U.S. Navy, Pacific Division, Naval Facilities Engineering Command. This project is being supervised by Jeffrey Dodge, Historical Architect, NAVFAC Hawaii. The photographic documentation was undertaken by David Franzen, photographer. Don Hibbard, Architectural Historian at Mason Architects, Inc., wrote the description, Dee Ruzicka wrote the historic context. The field work and research was conducted for this report by Don Hibbard in December 2008.

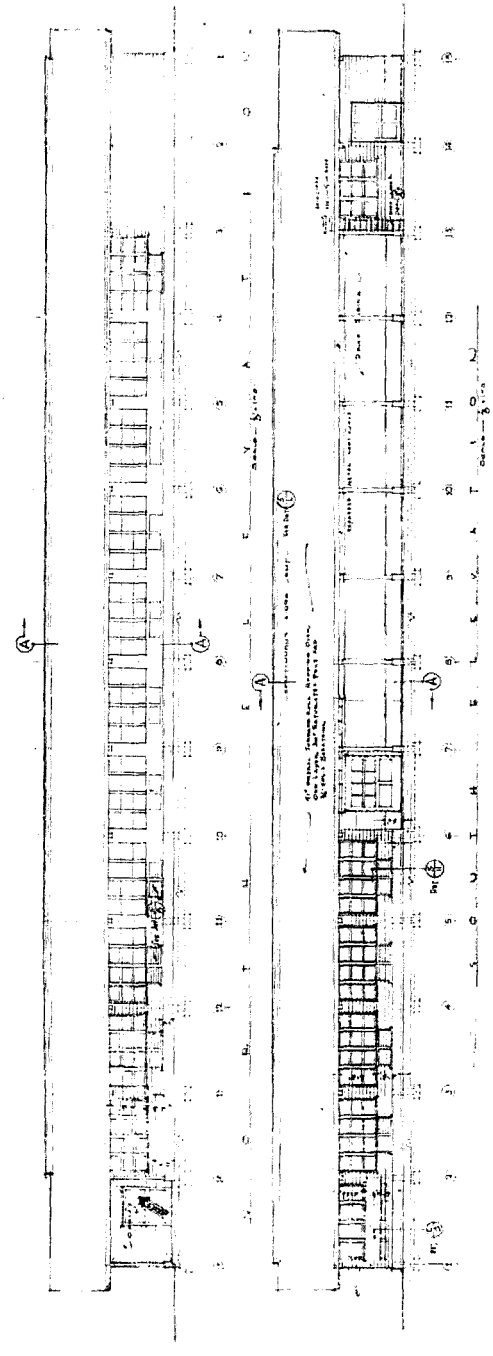
Location map



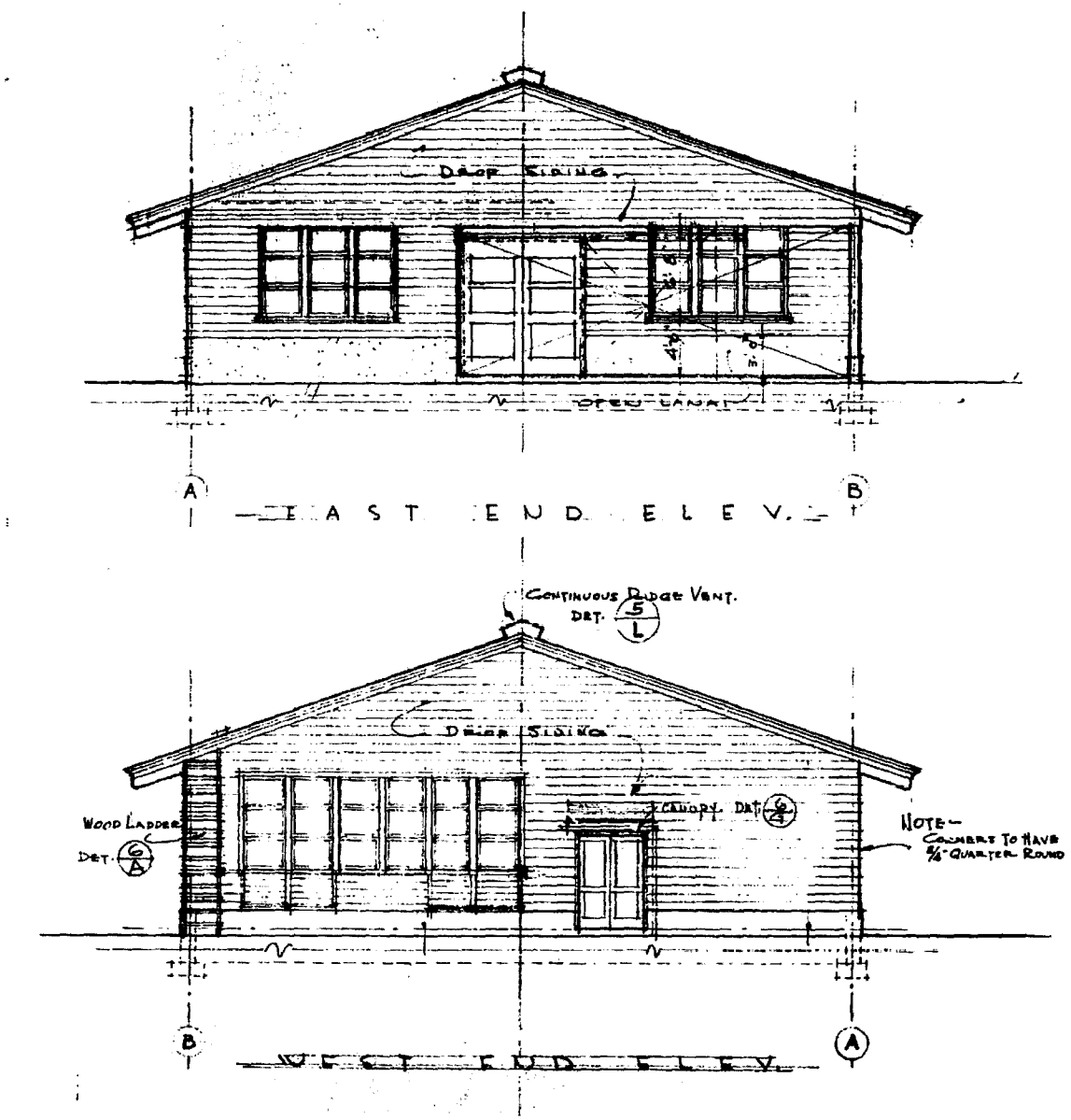
Facility 40 floor plan. Added key at bottom shows the names of individual rooms/ areas.
Portion of NAVFAC Drawing No. OA-N4-783, dated May 4, 1942.



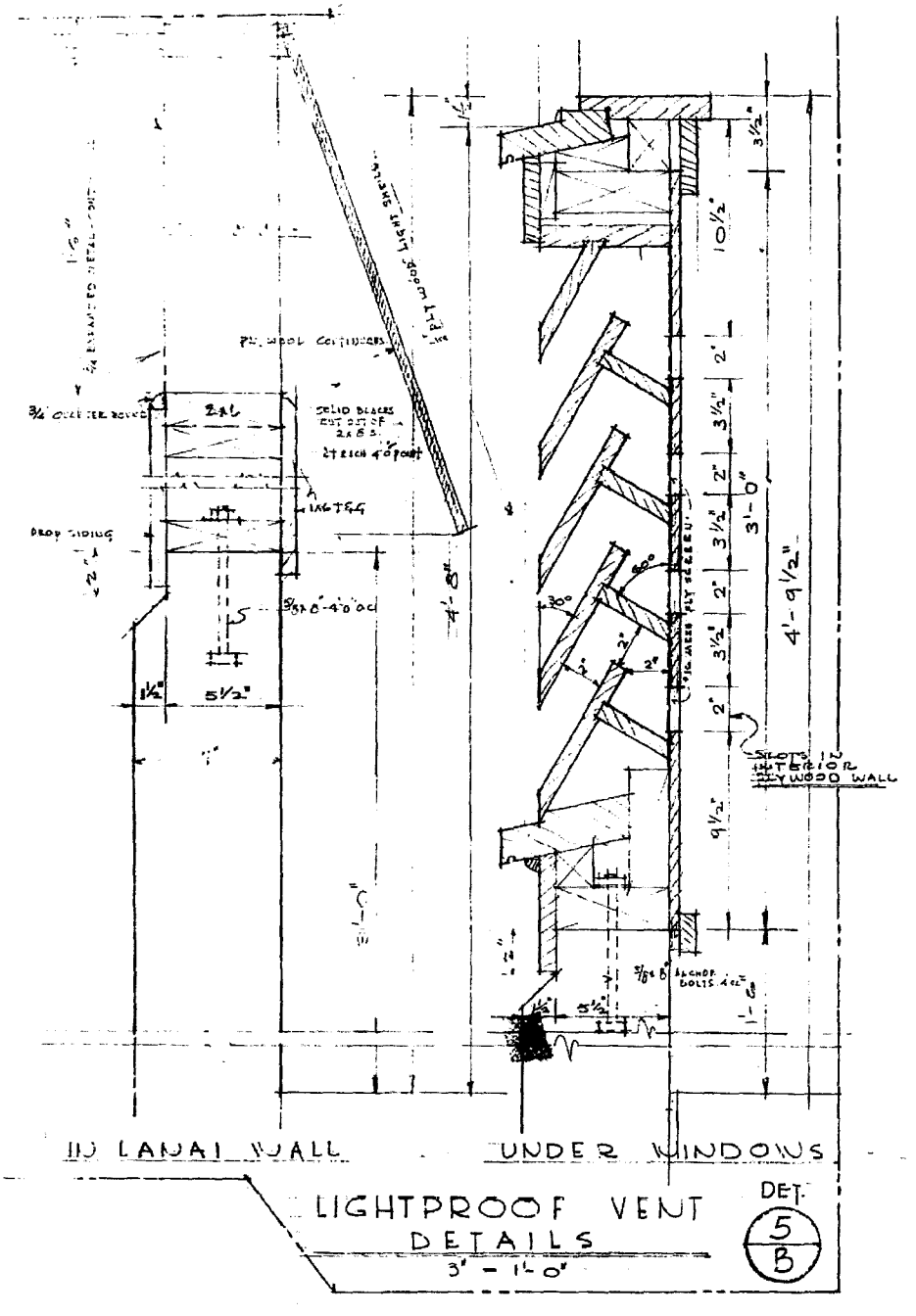
Facility 40 elevations. Portion of NAVFAC Drawing No. OA-N4-784, dated May 4, 1942.



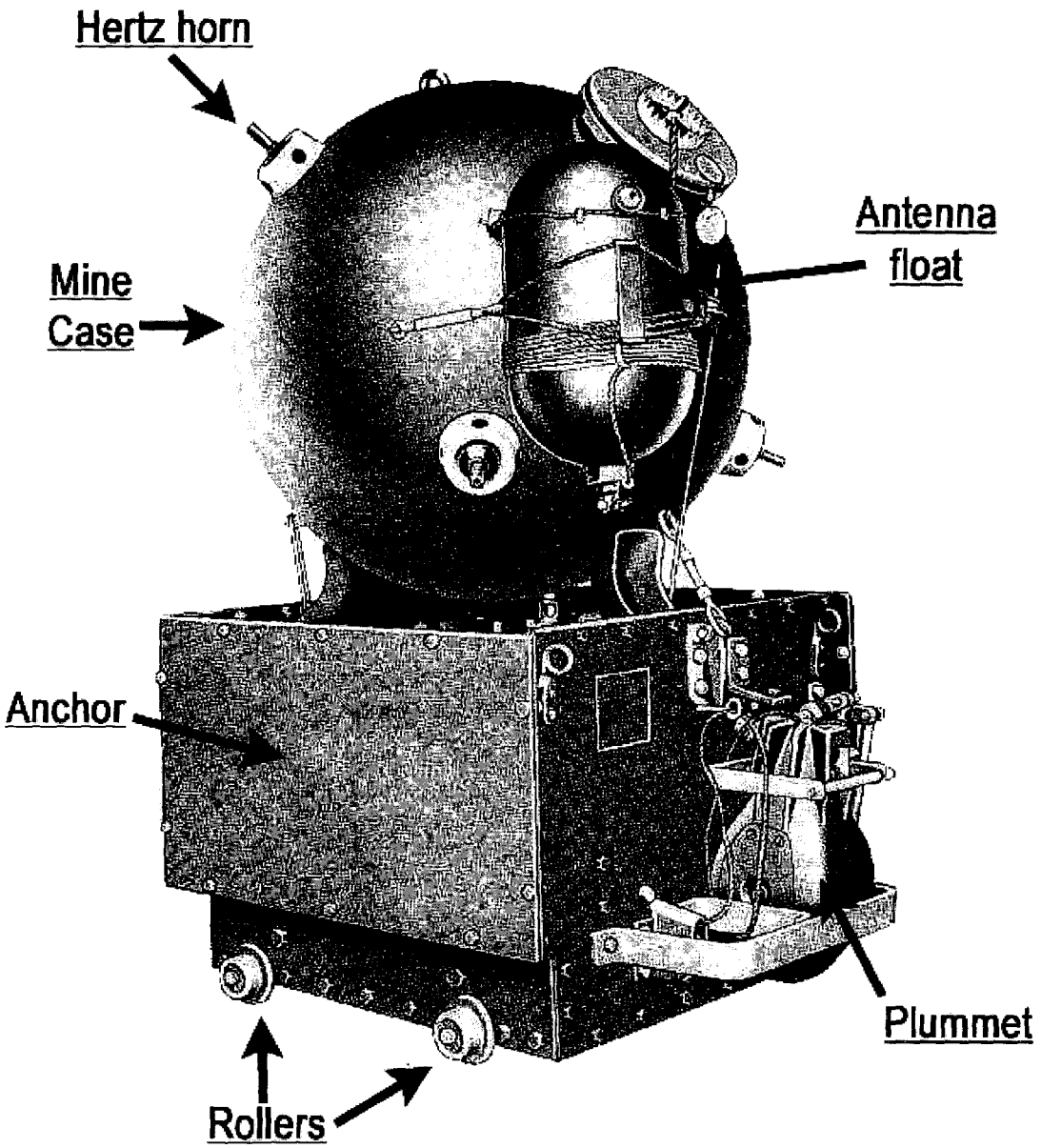
Facility 40 end elevations. Portion of NAVFAC Drawing. No. OA-N4-784, dated May 4, 1942.



Facility 40, detail of lightproof louver vent. Portion of NAVFAC Drawing. No. OA-N4-784, dated May 4, 1942.



Sketch showing Mk 6 mine as set up for deployment (labeling added). Department of Ordnance and Gunnery, 1957.



Drawing shown the planting sequence of a Mk 6 mine when deployed from a surface vessel. Department of Ordnance and Gunnery, 1957.

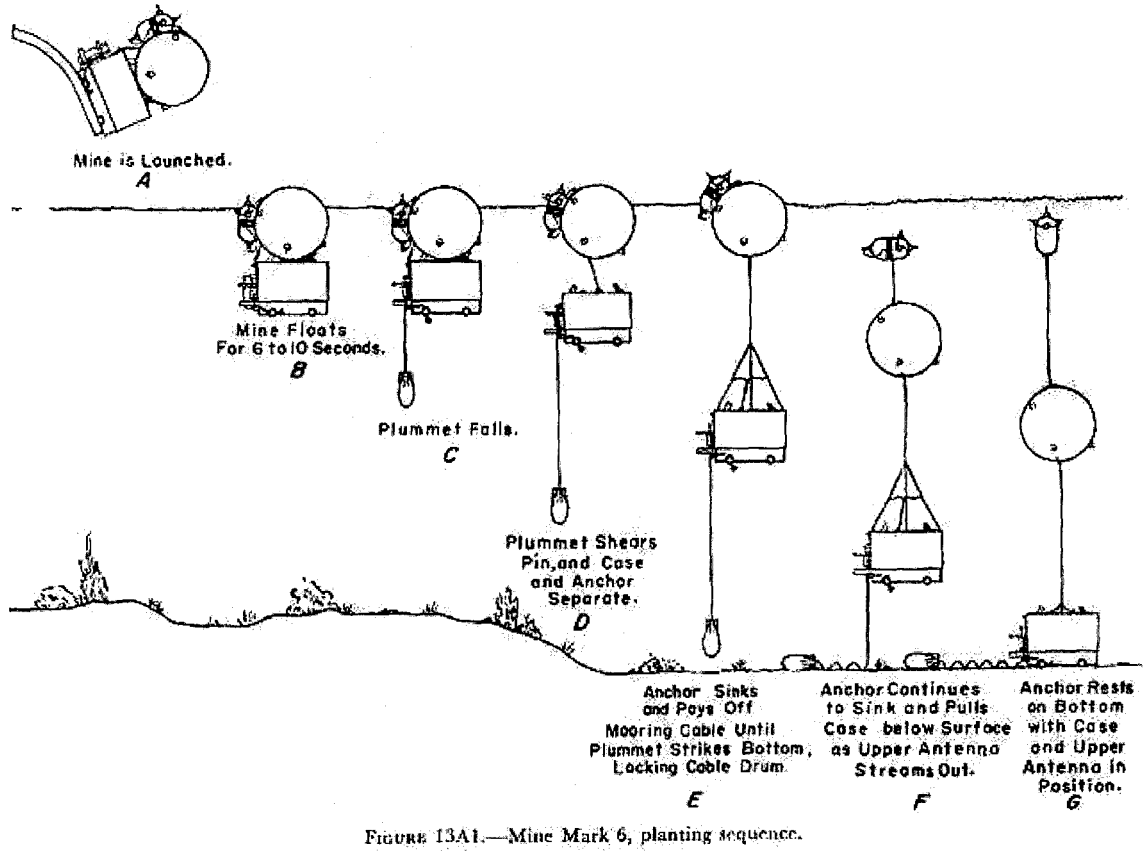


FIGURE 13A1.—Mine Mark 6, planting sequence.

Drawing showing a cross section of an extender mechanism for arming a Mk 6 mine.
Department of Ordnance and Gunnery, 1957.

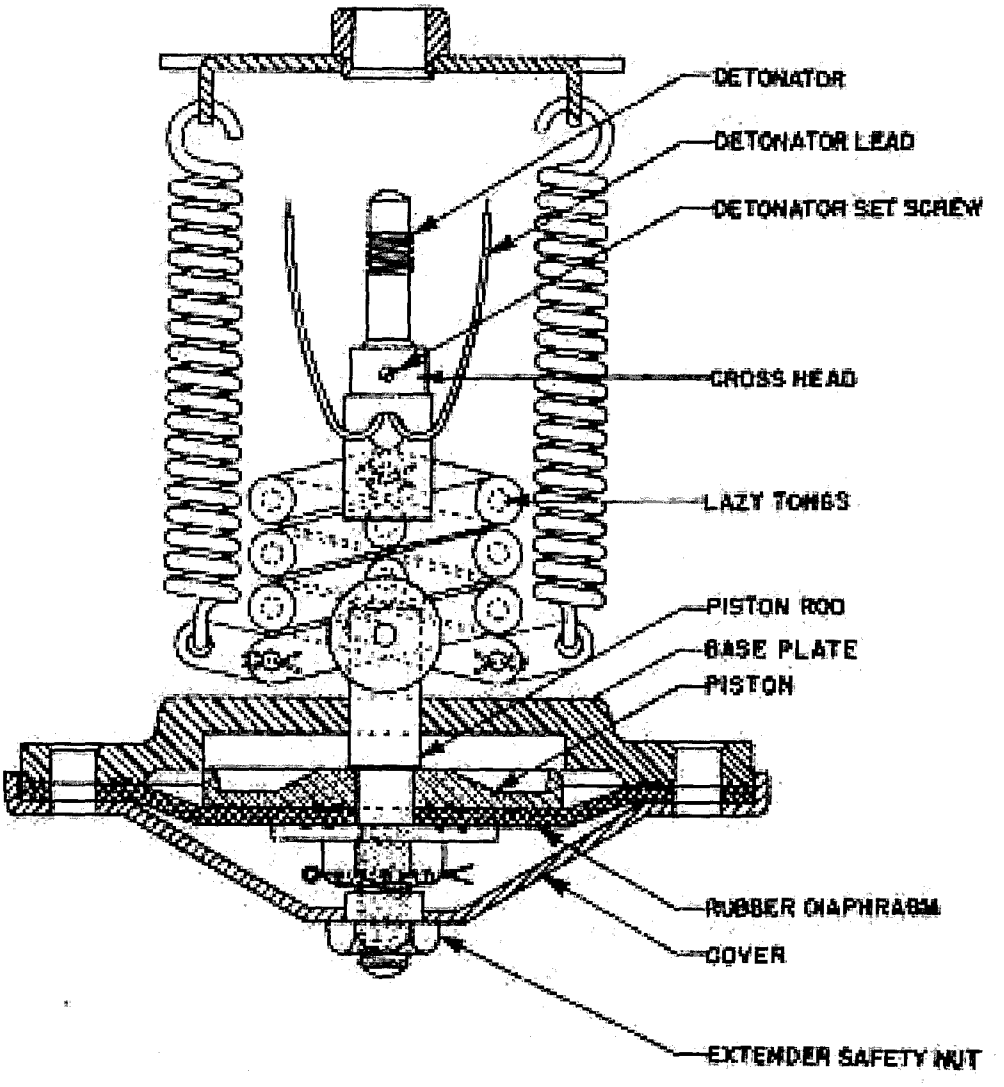
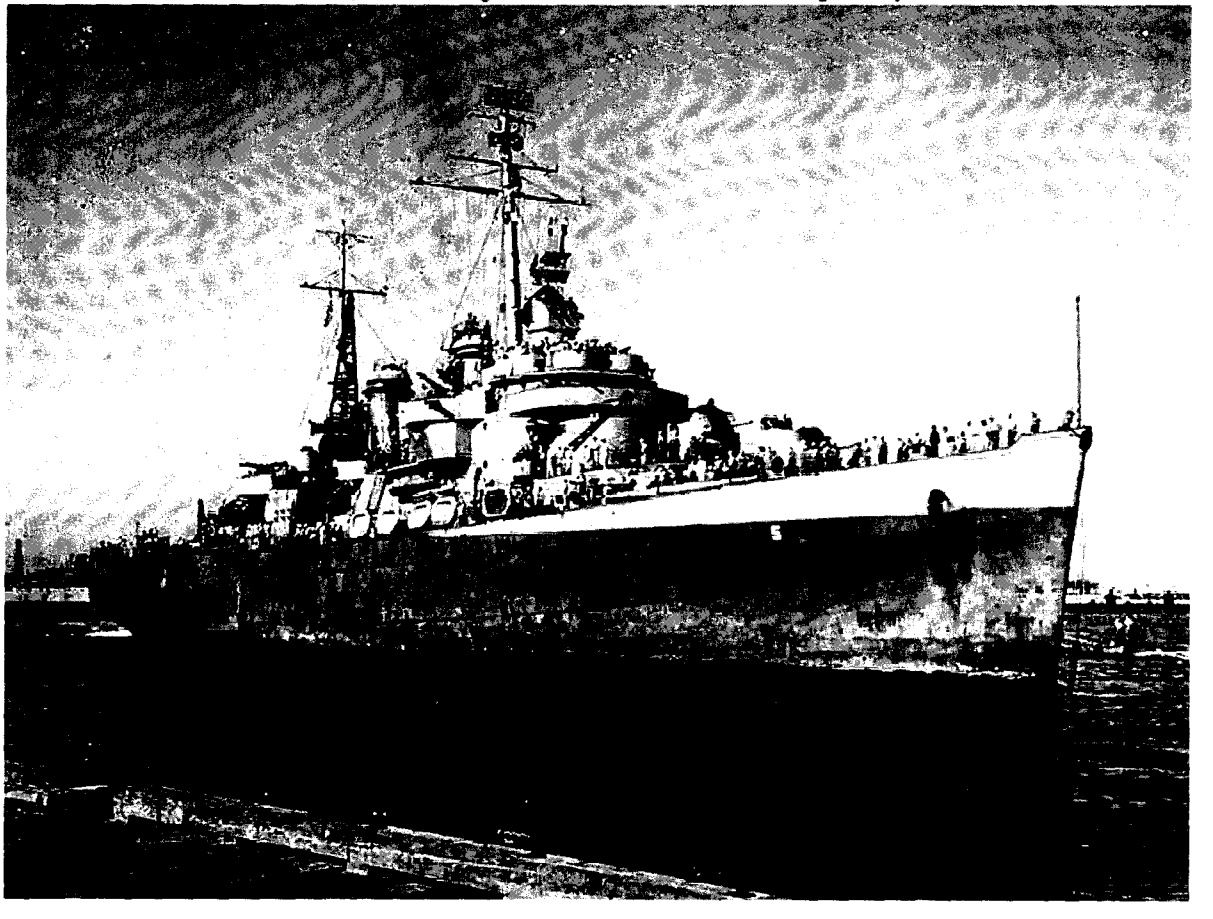


FIGURE 13A2.—Extender mechanism Mark 6 Mod. 2.

Historic photo dated may 1945 showing the minelayer USS *Terror* (CM-5) arriving at Pearl Harbor after being damaged by a kamikaze attack during the battle for Okinawa. The *Terror* operated out of Pearl Harbor between October 1943 and August 1945, resupplying with mines from West Loch. National Archives Photo, May 1945.

USS Terror (CM-5) arriving at Pearl Harbor with kamikaze damage in May 1945



Historic photo of USS *Terror* (CM-5) after repair of damage suffered during the battle for Okinawa. Note the openings at the stern of the vessel. National Archives Photo # 19-N-88289, August 9, 1945.

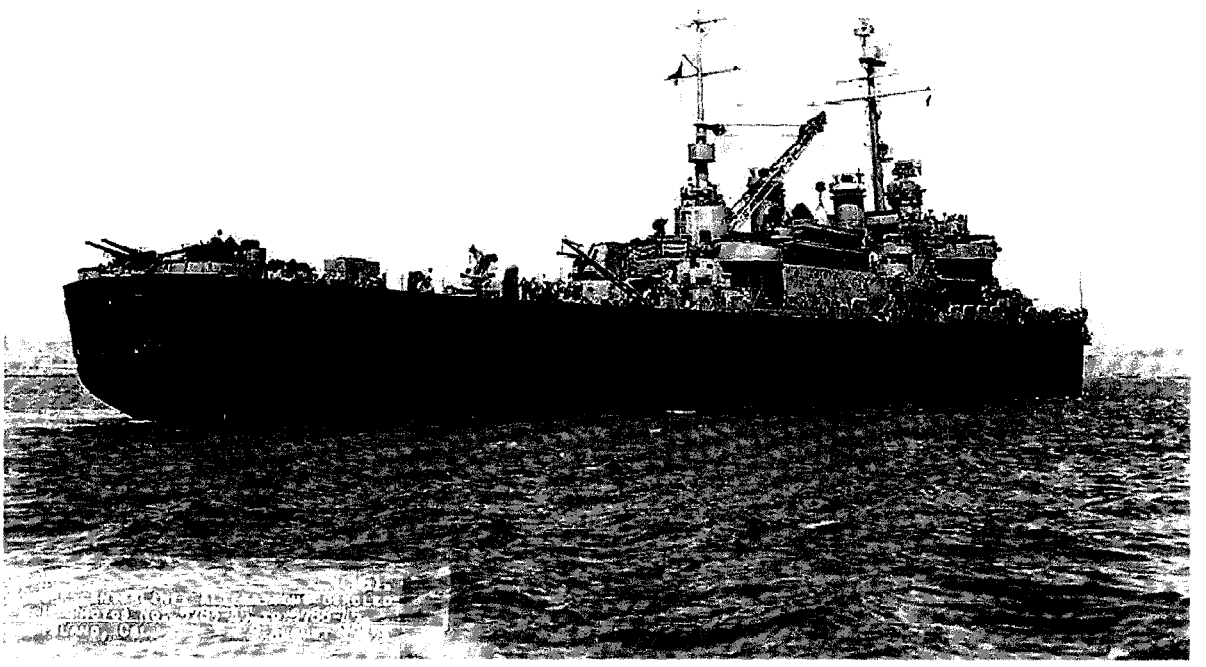



Photo No. 19-N-88289 USS Terror (CM-5) on 9 August 1945