U.S. NAVAL BASE, PEARL HARBOR, NAVAL RADIO STATION, OPERATIONS BUILDING
(Naval Computer & Telecommunications Area Master Station, Operations Building)
(Pacific NCTAMS PAC, Facility 294)
Wahiawa
Honolulu County
Hawaii

HABS HI-522-A
HI-522-A
HABS
HI-522-A

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

FIELD RECORDS

HISTORIC AMERICAN BUILDINGS SURVEY
PACIFIC WEST REGIONAL OFFICE
National Park Service
U.S. Department of the Interior
1111 Jackson Street, Suite 700
Oakland, CA 94607

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(Naval Computer & Telecommunications Area Master Station, Operations Building)
(Pacific NCTAMS PAC, Facility 294)

HABS No. HI-522-A

Location: Wahiawa
City and County of Honolulu, Hawaii

USGS 7.5 minute series topographic map, Hauula, 1992.
Universal Transverse Mercator (UTM) coordinates:
04.602400.2380260.

Present Owner: United States Navy

Present Occupant: United States Navy

Present Use: Vacant

Significance: Facility 294, the operations building for the AN/FRD-10 Circularly Disposed Antenna Array (CDAA) at NCTAMS, was a part of the United States' Cold War efforts to gather foreign intelligence information. Facility 294 was the location for the intercept operators of the antenna array. This building and array, along with fourteen other FRD-10 CDAAs and operations buildings worldwide, were a part of the Naval Security Group's Classic Bullseye network, a program for strategic intelligence collection and transmitter locating.

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PART I. DESCRIPTION

Facility 294 is a two-level, windowless, rectangular-plan building that measures 88'-0" x 112'-0". It is located at the center of Facility 314, the Circularly Disposed Antenna Array (CDAA), which is a circular structure whose above-ground components include four concentric rings of vertical antenna elements and reflector screens. Facility 294 and its associated CDAA are situated at the center of a large cleared and leveled area approximately 1300' in diameter. The area near the vertical antenna elements and reflector screens of the CDAA has been covered with gravel, while the areas beyond the gravel ring and between it and Facility 294 have been planted with grass.

Facility 294 has a very-low-slope gable roof with no eaves. The height from grade to roof averages about 18'. Although the grade rises and dips slightly around the building, generally about two-thirds of the basement's 15'-4" height is below ground. Facility 294 is built of concrete at the basement level and has a concrete frame with walls of concrete masonry units (CMU) on the main level. The northeast side has large metal panels of fixed louver vents. There are also double louvered doors of metal at the transformer room entry. All other exterior doors are flush metal, whether single or double. On the southeast and southwest sides, doorways to access the main floor are reached by concrete stairs with metal pipe railings. Near the center of the southeast side, where the grade dips slightly, there are adjacent single and double flush doors. These open, respectively, on a stairway landing and a loading platform 10'-0" above the basement floor. The southwest and northeast sides each have an enclosed stairwell leading to the basement level. An unenclosed stairwell leads to two basement-level entries on the northwest side of the building.

Facility 294 has two shed-roof projections on its southeast side which protect air conditioning equipment. The roof height of these projections is about 9' and they are open on two sides. On each projection the wall supporting its roof is parallel to the wall of the main building and is built of CMU.

A shed roof, supported by steel I-beam posts, is located over the northwest side's unenclosed stairway to the basement. Another shed-roof projection on the northwest side, supported by metal pipe posts, protects air-handling equipment. An additional shed-roof projection is located on the southwest side, between the two entry stairs to the main level. This is supported by wood posts with a wood railing and has a wood deck 1'-4" above grade.

The Navy did not allow access to the interior of Facility 294 for this report, but building drawings from Plan Files of the Naval Facilities Engineering Command, Pacific reveal the layout of the interior. The main space at the basement level is the goniometer room, measuring 39'-2" square, which is centered on the center point of the CDAA. The coaxial cables which carried signals from the antenna elements of the CDAA entered this room through four openings, one in each of its side walls. The goniometer, housed in this room, processed the signals to enable direction finding.

The main level of Facility 294 has a direction finder room 39'-10" square that is positioned directly above the goniometer room. Here, signals from the goniometer were recorded and analyzed. The main level also has office areas for operations, high frequency direction finding, support, communications, maintenance, and F.C.C. operations. Other spaces on this level are rooms for teletype and electronics repair, incinerator room, dark room, toilet, utility room, and janitor's closet. The upper part of the mechanical and generator rooms are also extended up through this story.

Just off the north corner of the paved apron that surrounds Facility 294 is a small power generator building, Facility 384. This single-story building is constructed of CMU with a bi-level flat roof with overhanging eaves. The higher-roof portion was a 1980s addition to the 1966 building.

A metal-frame tower, about 35' high is located just off the southwest edge of the paved apron surrounding Facility 294. The tower is square in plan (measuring about 7' on a side) and is constructed on a concrete slab. The four tubular uprights of the tower are braced with diagonal tie rods on the five lower sections and wider L-angles at the top two sections. There is a metal ladder that extends up to a platform at its top, which is edged with pipe railing.

PART II. HISTORICAL CONTEXT

For a detailed examination of the history and operation of the FRD-10 CDAA see HABS HI-522-B, this discusses the AN/FRD-10 Circularly Disposed Antenna Array (Facility 314) at the Naval Computer and Telecommunications Area Master Station, Pacific.

Operation of the FRD-10

The two rings of antenna in the FRD-10 CDAA are set up to each operate optimally in a different high-frequency (HF) wavelength. The outer ring of 120 sleeved monopole antennas was designed to receive shorter (low band) HF wavelengths from 8-30 MHz. The inner ring of 40 folded dipole antennas receives the longer (high band) HF wavelengths between 2-8 MHz (Proc 2006, [12]). The two screens of vertical wires that are suspended from the wood poles serve to shield the antenna elements on one side of the CDAA from interference that would be created by signals crossing from the other side. The wire ground mat and radial wires buried in the ground beneath and in a band beyond the antenna rings also served to isolate the incoming signal for better results.

The individual antenna elements of the rings were sequentially connected to radio receivers in the operations building in the center of the array. A contiguous number of antenna elements which spanned a segment of the circle of the CDAA were usually connected at any given moment. This segment of activated antenna formed a pattern which swept rapidly around the ring, covering all points of the compass. An antenna which sweeps its beam using electronic pulses moving across its face is termed "phased." This is in contrast to a manually swept antenna, such as a rotating satellite dish. The signals received from each ring of the antennas were relayed through a goniometer (an instrument that allows a precise determination of the angular direction of a rotating object or signal). The goniometer switches the antenna elements sequentially, alternating connected and disconnected elements to produce a beam that swept around the CDAA and covered all directions. By monitoring the signal strength as the activated segment moved around the circle, the direction of a radio signal could be very accurately

determined. The details of the phasing of the antenna elements and the goniometer circuitry are "presumed to be classified" (Proc 2006, [12]).

The signals from the antenna elements were routed through

> large 75 ohm, low loss coax [co-axial cable] which is meticulously phase matched across the antenna array before it enters the operations building at the center. Maintaining tolerances of less than an inch are important. The cables then enter a series of primary antenna multicouplers that function to distribute the RF energy from each element. One tap of the low band multicoupler goes to a goniometer which switches the elements electronically and provides a 'chopped' version of the RF band which is then used in either sum or difference modes to resolve azimuth information. There is a separate goniometer for the high band array. Other outputs of the multicoupler connect to secondary multicouplers whose outputs are then presented to the receivers [R-390A]. Because the goniometer was electromechanical in nature, its sector switches were electrically noisy, a slight determent to its operation (Proc 2006, [12]).

In addition to determining the direction from which a signal originated, the various FRD-10 sites around the globe were in contact with one another which enabled triangulation of the source of the signal by comparing bearings from two or more FRD-10s. "The FRD-10 provided a near instantaneous bearing of any signal that appeared on the radio spectrum for even a fraction of a second. When combined with the information from other FRD-10 sites operating in real time, a bearing could be obtained immediately and it would be virtually impossible to hide any HF transmissions" (Proc 2006, [12]).

The FRD-10 CDAAs were an improvement over earlier CDAA units. They allowed transmissions to be recorded for subsequent direction finding. The bearings obtained were up to four times as accurate as previous antennas, with results of better than 0.5 degree. Signal amplitude (gain) was four times greater, and the FRD-10 was better able to filter out interfering signals and noise (Proc 2006, [15]).

"The improvement expected as a result of deploying the FRD-10s was a combination of more accurate and reliable fixes, producing reduced search areas in ocean areas of prime responsibility so fresh in time, as to enable maritime commanders to deploy their forces more economically and with much greater prospect of making contact with the target than is now the case" (Proc 2006, [15]).

Classic Bullseye

The AN/FRD-10 CDAA and its associated operations building (Facility 294) at NCTAMS was built in 1963 as part of the network of 14 land-based, high-frequency direction finders of the same design that were used in the Classic Bullseye program. Classic Bullseye CDAAs were built at the following locations: Adak, AK; Marietta, WA; Skaggs Island, CA; Imperial Beach, CA; Wahiawa, HI (NCTAMS); Guam, Mariana Islands; Hanza, Okinawa, Japan; Winter Harbor, ME; Northwest, VA; Homestead, FL; Sabana Seca, PR; Galeta Island, Panama; Edzell, Scotland; and Rota, Spain. Classic Bullseye was a Department of Defense program which gathered strategic intelligence and determined the location of transmitters. Classic Bullseye was managed by the Naval Security Group (NSG) Command. The High-Frequency Direction-Finding (HFDF) FRD-10 antenna and their operations buildings intercepted and located voice

transmissions and message traffic that was broadcast on short-wave (HF) channels (Pike 2001).

R-390A Receiver

The intercept operators inside Facility 294 would have used type R-390A radio receivers at their consoles. This receiver was designed and initially manufactured as the R-390 receiver by the Collins Radio Company. This firm was established in 1933 by Arthur Collins in Cedar Rapids, Iowa as a producer of short-wave equipment. The R-390A receiver was a military-requested re-design of Collins' original R-390 which lowered the cost, reduced the number of vacuum tubes, and employed improved filtering techniques (mechanical filter) to enhance the signal. Most of the R-390A's parts are not interchangeable with the R-390. The original R-390 was introduced in 1950 and its re-designed version, the R-390A, was first produced in 1953. Neither unit appears in a 1959 Collins Radio Company catalog, but this is not surprising as the R-390A was a "classified" design until the mid 1960s (Rippel 2006). R-390A receivers first went on sale to the public in 1968 for a price of $1,700 (Rippel 2006).

The R-390A was incorporated in the AN/FLR-7 CDAA antenna that was made operational in 1960. Later CDAAs, the Army FLR-9 and the Navy's FRD-10, the type of CDAA built at NCTAMS PAC Facility 314, also used the R-390A. Manufacturers of later R-390A units included Stewart-Warner, Amelco, and Motorola. It was produced in large quantities (over 61,000 units) until 1984 (Rippel 2006). The R-390A is considered one of the finest HF radio receivers ever built. It is one of the largest vacuum-tube-type receivers commonly used, weighing between 75 and 85 pounds.

The R-390A receives signals between 0.5 and 32 MHz and is especially useful for receiving multi-channel radio-teletypewriter signals. It was designed to be used for military and government signals intelligence (SIGINT) collection, point-to-point radio circuit operation, operation from field-transportable communications shelters, and shipboard communications. The R-390A was also used for communications during the Apollo Space Program. This receiver has the ability to operate well under conditions where there are powerful transmitters nearby which would create interference for many other types of receivers (Tirevold 2006). R-390A receivers "found service with the CIA and NSA to monitor communications from behind the Iron Curtain. During the Cold War years, the R390A was so valued it was classified TOP SECRET, a security measure which remained in force until the mid-1960s. Stories are told that R390A's [sic] are still in use by the NSA where senior operators far prefer their quiet, yet stellar performance over mega-dollar receivers" (Rippel 2006).

Building and Site Modifications

Originally, much of the basement level was left unfinished, according to the 1962 building drawings (NAVFAC drwg 929481. This drawing shows the 39'-2" square goniometer room was almost surrounded by unfinished space with an earth floor. The only finished spaces that were labeled on the original drawings near the goniometer room, were the 17'-7" wide loading dock area at the southeast side and the transformer vault and passage to the unenclosed stairs at the north corner. The other original finished space in the basement was the mechanical equipment and generator room along the northeast side. This was separated from the goniometer room by a 25'-0" wide section of unfinished basement with an earth floor. By 1972, rooms had been added for maintenance and SPECOMM (Special Communications) in the formerly unfinished space to the west and south of the goniometer room. Also by 1972, the unfinished space to the

northeast of the goniometer room (between the goniometer room and the mechanical/generator room) had a concrete floor installed. In 1972, at the north end of this area, a 10'-0" x 12'-9" toilet and shower room plus an adjacent 7'-0" x 9'-6" sewer ejector pit was constructed (NAVFAC drwg 7001661).

Some time after 1969 the paved parking area was added off the south corner of the apron surrounding Facility 294 (Hawaii State Archives photo).

After 1988 a 1'-1" high and 1'-8" wide concrete curb carrying a 4" diameter PVC water pipe towards Facility 294 was added. This curb is formed with a u-shaped channel to carry the pipe and enters the antenna rings running along the north edge of the roadway. This curb and water pipe were probably added to avoid cutting through the copper wire ground mat that is buried under the antenna elements and reflector screens. The open top of the channel carrying the pipe is covered with narrow sections of weather-resistant pressed board, each about 4' long. The water pipe runs underground at a point near the north corner of the paved apron surrounding the building.

In 1976 two emergency exit stairwells were added to Facility 294 (NAVFAC drwg 7012092). These are the enclosed stairwells at the southwest and northeast sides. The two open-sided shed-roof projections on the southeast side of Facility 294, which protect air conditioning equipment, were added after 1976 (drwg 70120092).

PART III. SOURCES OF INFORMATION

A. Architectural Drawings:

Historic drawings are available as electronic scans only, and were 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. Original (1962) drawings were produced by Indenco Engineers, Inc., of Honolulu, HI and the 14th Naval District Public Works Office.

B. Early Views:

Aerial photos taken during the time of construction (1962-63) are located in the Still Photo section of the National Archives and Records Administration (NARA), in College Park Maryland. They are filed as RG 428-GXA: #s 1077670 thru 1077673, and 1077694. NARA aerial photos dated August 20, 1964 are in RG 428-N: #s 1108494 thru 1108496. Another photo dated April 26, 1966 is filed as RG 428-N: # 1118376.

An aerial photo dated December 5, 1969 is found in the Hawaii State Archives, Folder PPA-52-3, photo 5203-5. Photos of later dates can be found on the website maintained by Joseph Glockner (navycthistory.com).

C. Bibliography:

Finnegan, John Patrick. *The Military Intelligence Story, A Photo History.* Fort Belvoir, VA: U.S Army Intelligence and Security Command, 1994.

Glockner, Joseph A. An unofficial Navy CT history website at www.navycthistory.com/hawaii_mid-pac.html accessed on November 3, 2006.

Pike, John. Global Security. *NCTAMS PAC Wahiawa, Hawaii.* 2005. Website www.globalsecurity.org/military/facility/wahiawa.htm accessed on November 7, 2006.

_____. AN/FRD-10 Classic Bullseye. Washington, D.C.: Federation of American Scientists, 2001. Website www.fas.org/irp/program/collect/classic_bullseye.htm accessed on November 3, 2006.

_____. Naval Security Group Command, Operations. 1997. Website www.fas.org/irp/agency/navsecgru/ops.htm accessed on December 12, 2006.

Proc, Jerry. CFS Masset, section in Radio Communications and Signals Intelligence in the RCN. Webpage www.jproc.ca/rrp/masset.html accessed on October 24, 2006. [Page numbers based on landscape format.]

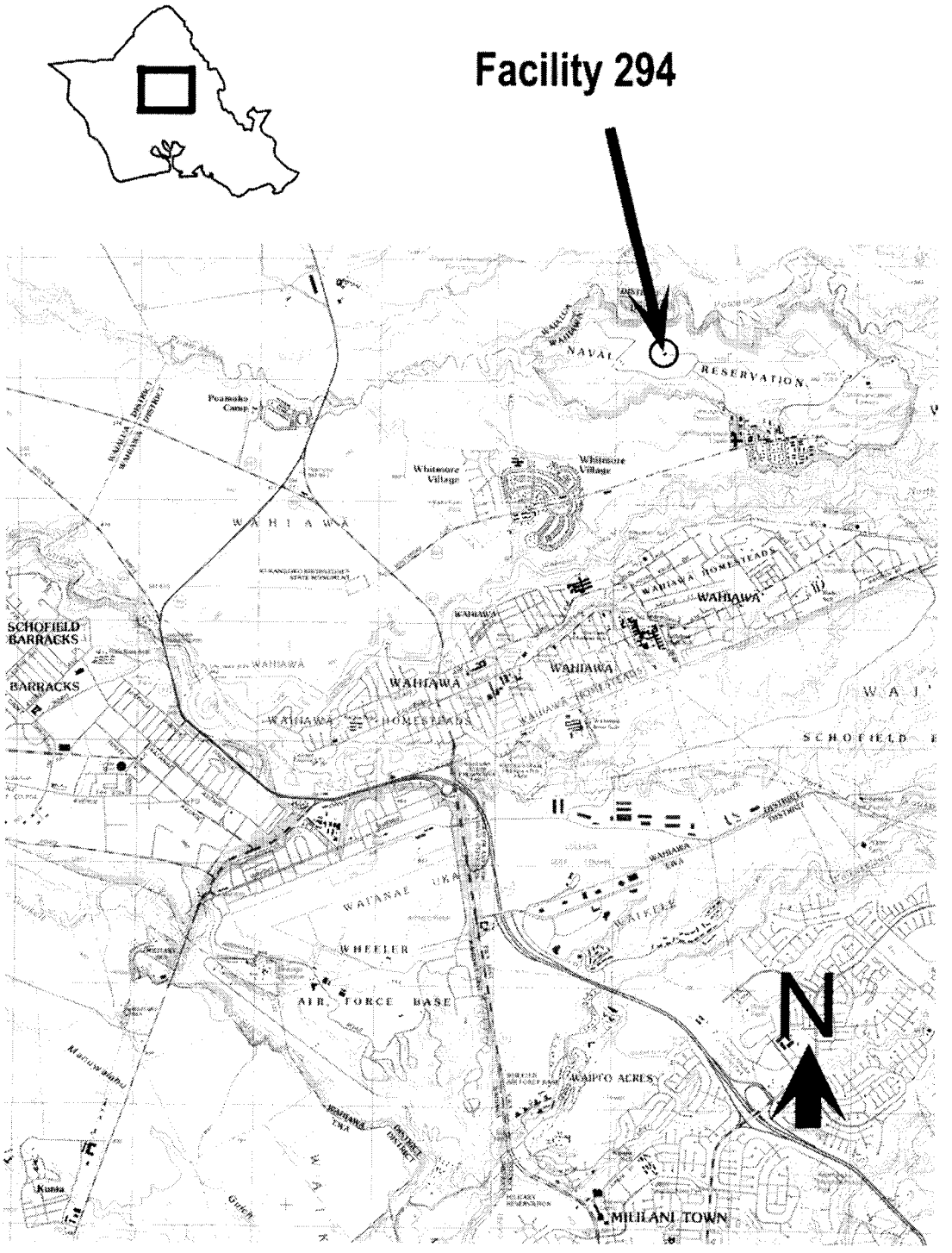
Rippel, Chuck with Les Locklear. *The R390A/URR.* Website www.r390a.com/html/history.htm accessed on November 13, 2006.

Tirevold, Al. Frequently Asked Questions Page. Website www.r-390a.net accessed on November 3, 2006.

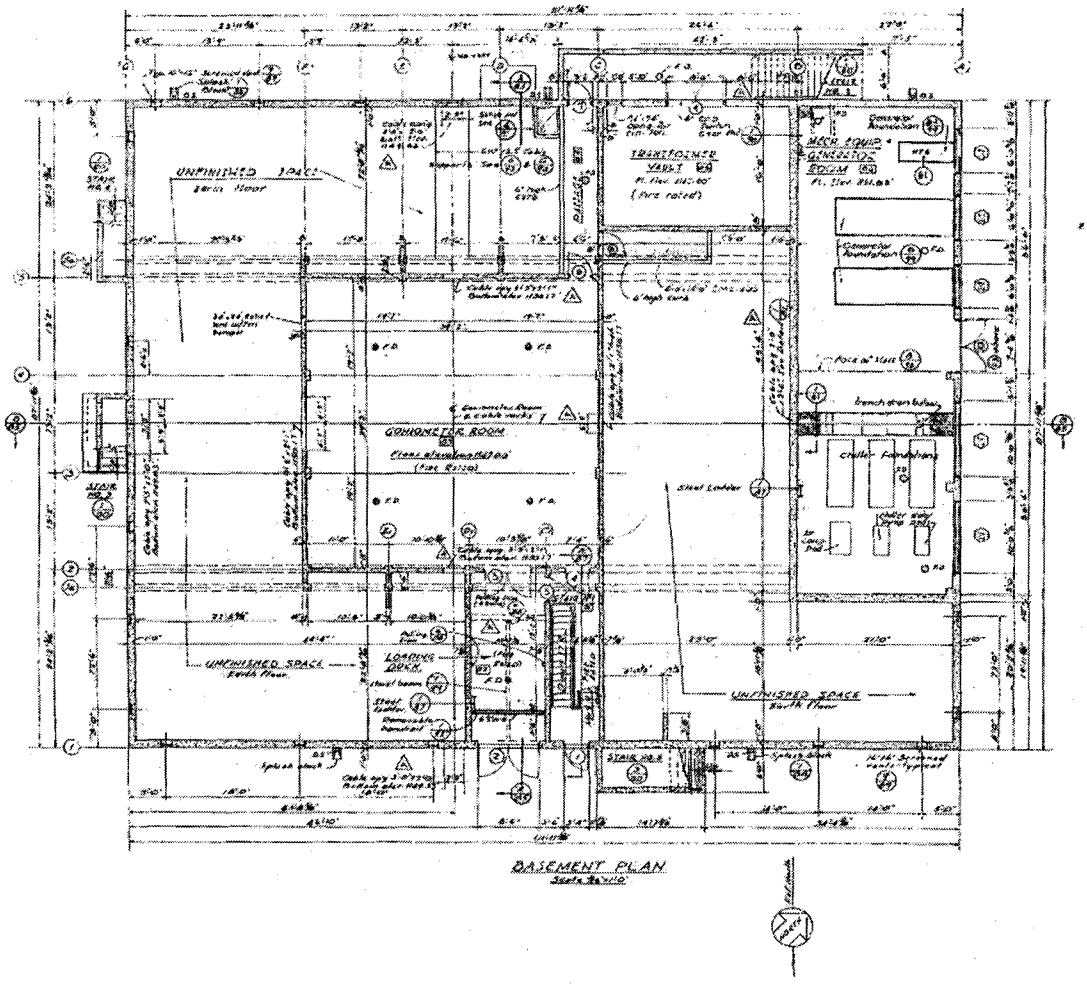
PART IV. PROJECT INFORMATION

This documentation is being undertaken after consultation with the Hawaii State Historic Preservation Office and prior to the demolition of the CDAA (Facility 314) and its Operations Building (Facility 294). The site will be used for the Hawaii Regional Security Operations Center (HRSOC). The large-format photographs were taken on October 23, 2006 by David Franzen of Franzen Photography. The report was researched and written by Dee Ruzicka, Architectural Historian at Mason Architects, Inc., Honolulu, Hawaii.

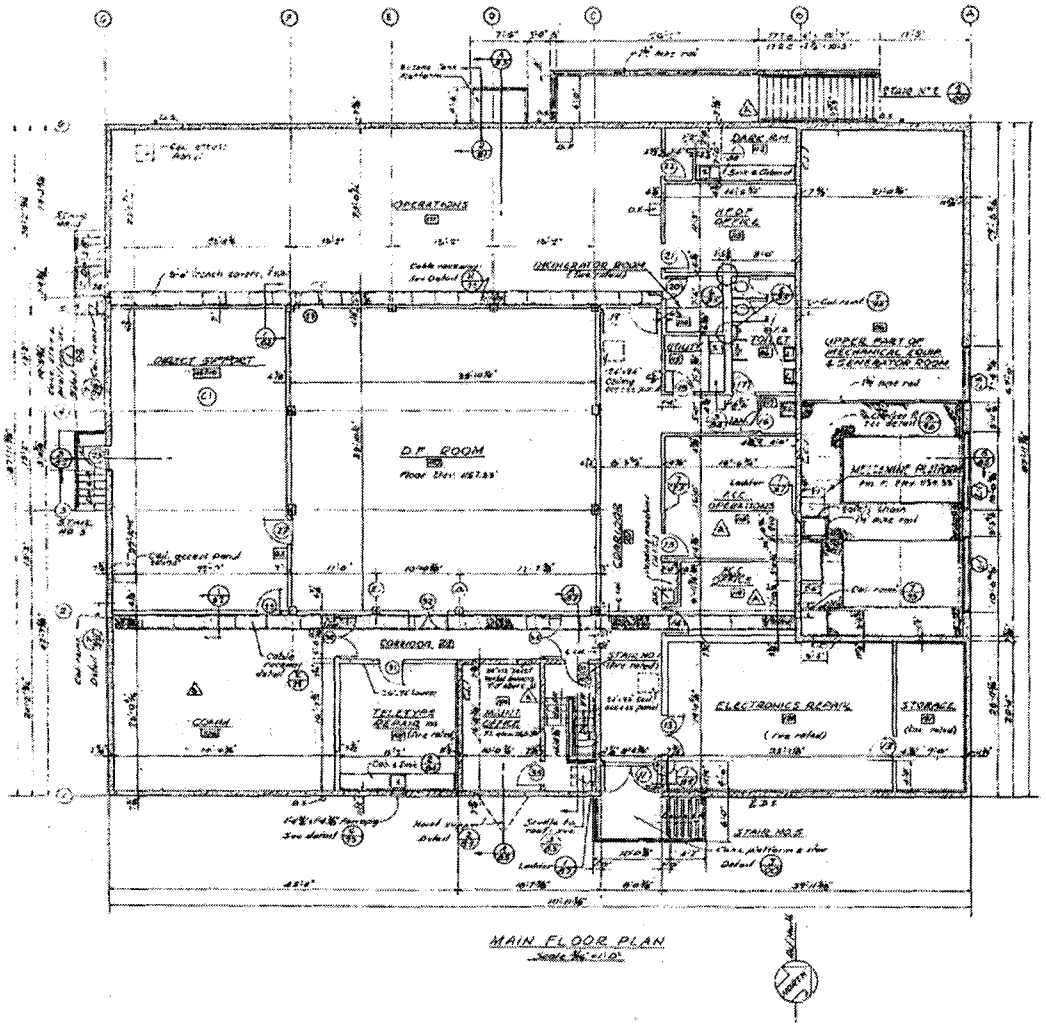
Location map.



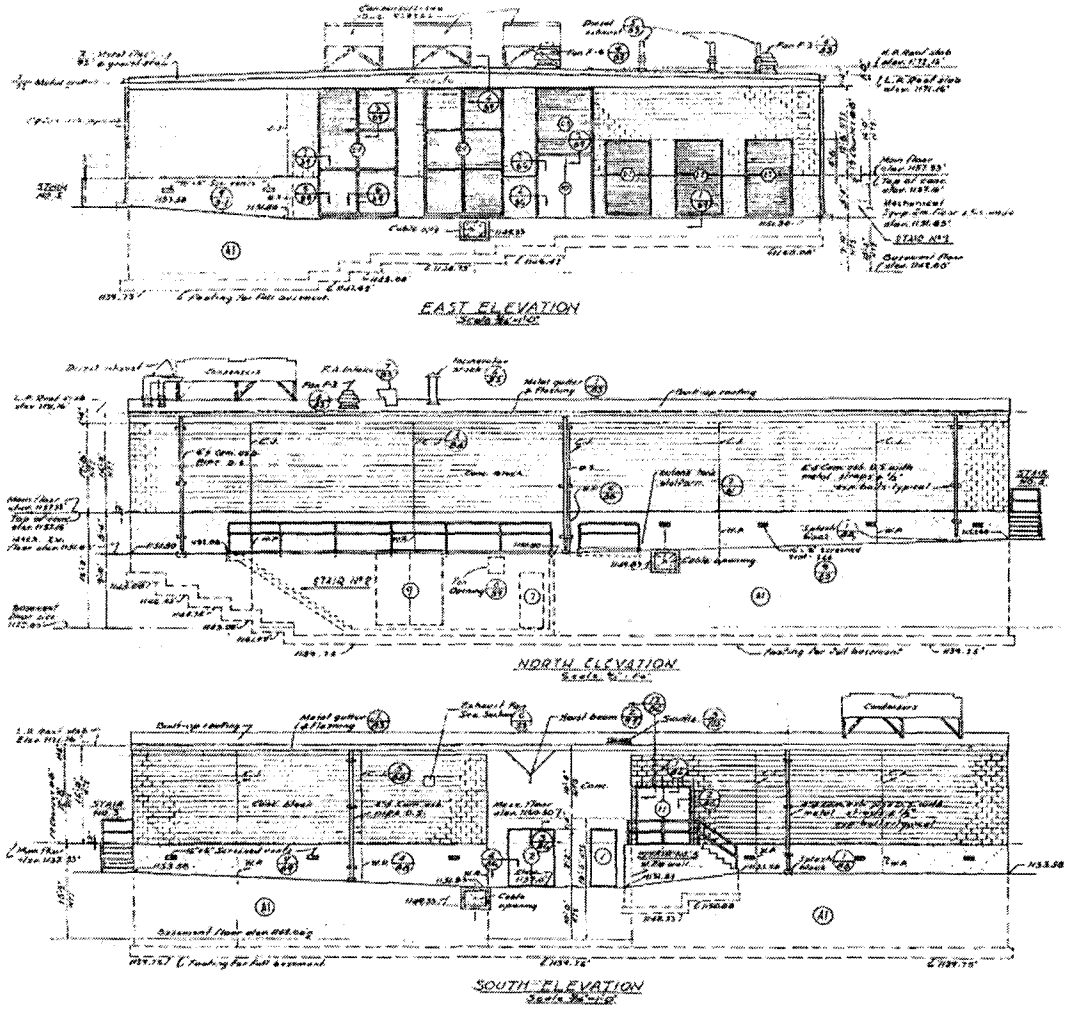
Portion of drawing dated April 20, 1962 showing the plan of the basement. Note the unfinished space with earth floor around the center goniometer room. NAVFAC drwg 929481.



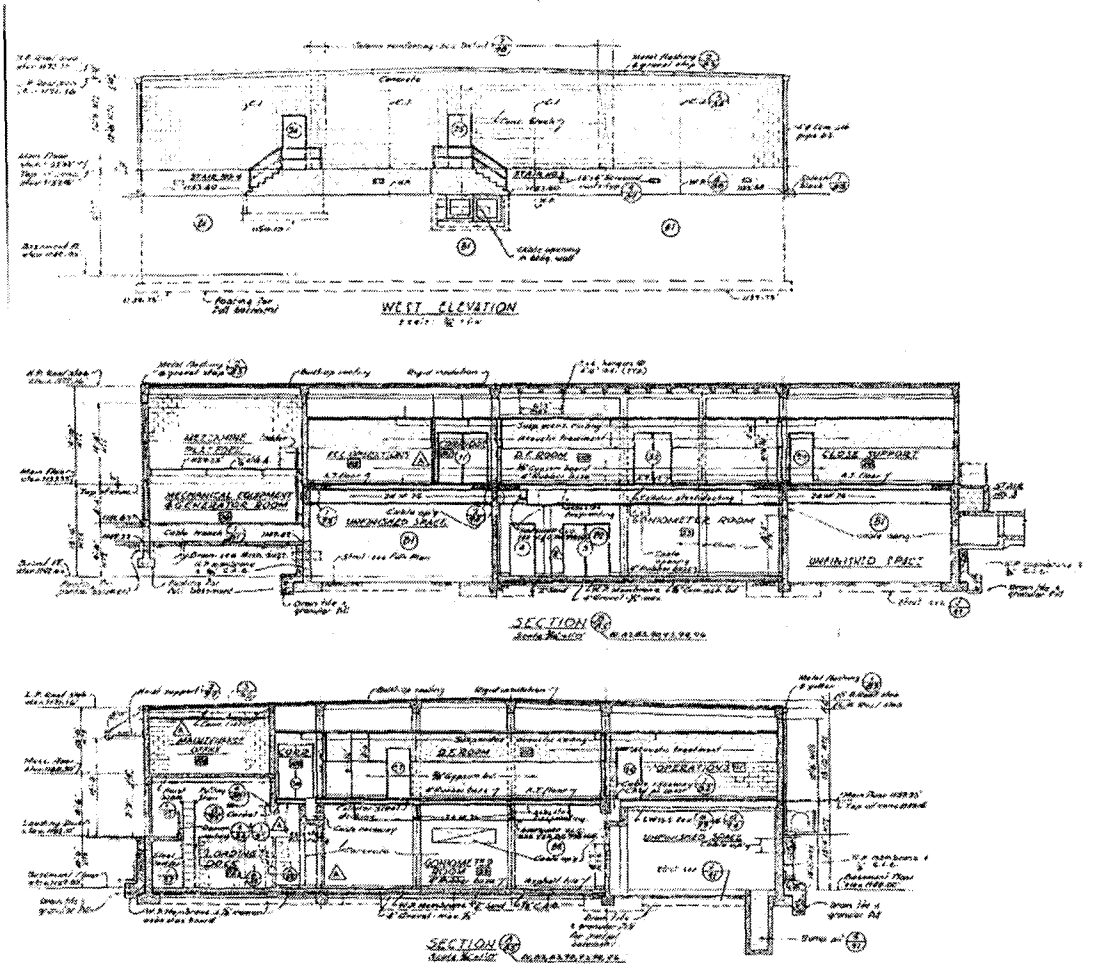
Portion of drawing dated April 20, 1962 showing the plan of the main floor level. NAVFAC drwg 929482.



Portion of drawing dated April 20, 1962 showing elevations. NAVFAC drwg 929484. Note that the labeling on this original drawing corresponds to the northeast, northwest, and southeast elevations as listed in the photo index for this report.



Portion of drawing dated April 20, 1962 showing elevation and cross sections. NAVFAC drwg 929485. Note that the labeling on this original drawing corresponds to the southwest elevation as listed in the photo index for this report.



Portion of drawing dated February 5, 1976 showing the added emergency exits from the basement level. NAVFAC drwg 7012092.