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JULY 1948

BUSHIPS Electron

MARE ISLAND NAVAL SHIPYARD

NavShips 900,100

Captain Wallace R. Dowd, U. S. N.
Commander Mare Island Naval Shipyard
Industrial Manager 12th Naval District

Wallace Rutherford Dowd
Captain, U. S. N.

Captain Dowd, Born in Fort Smith, Arkansas, October 22, 1896, attended the University of Arkansas before appointment to the U. S. Naval Academy, Annapolis, Maryland, in 1916. Graduated with distinction on June 6, 1919 with the Class of 1920, and commissioned Ensign that date, he subsequently advanced to the rank of Captain on June 18, 1942.

After graduation in 1919 Captain Dowd was assigned to the USS ARKANSAS *and served in that battleship until September, 1920. The succeeding three years he had instruction in Naval Construction at the Postgraduate School, Annapolis, at the Boston Navy Yard, at the Massachusetts Institute of Technology, and at the Edgewood Arsenal, Edgewood, Maryland. He received the degree of Master of Science in War Ship Construction in 1923 from the Massachusetts Institute of Technology.*

From September, 1923, until June, 1926, Captain Dowd was Assistant Shop Superintendent of the Navy Yard, Norfolk. He then served in the Planning Office, Navy Yard, Mare Island, until June 1929. The following month he reported for duty in the Production Office of the Navy Yard, Pearl Harbor, where he served until June, 1931.

Captain Dowd had duty with the Board of Inspection and Survey, Pacific Coast Section, from July, 1931, until December, 1933. He then reported to the Navy Yard, Charleston, and served there as Production and Planning Officer until June, 1937. The following month he assumed duty as New Construction and Shop Superintendent at the Navy Yard, Puget Sound, where he served until September, 1941. He then served in the Office of the Director of Shore Establishments, Navy Department, until April, 1942.

Captain Dowd was Supervisor of Shipbuilding, Chicago, from March, 1942, to April, 1944, and for his services in that assignment he was awarded the Gold Star in lieu of the Second Legion of Merit with the following citation:

"For exceptionally meritorious conduct in the performance of outstanding services to the Government of the United States as Supervisor of Shipbuilding, United States Navy, Pullman Standard Car Manufacturing Company, Chicago, Illinois, from March 1942, to April 1944."

After being detached from duty as Supervisor of Shipbuilding, Chicago, Illinois, Captain Dowd assumed duty as Head of the Materials Branch, Bureau of Ships, Navy Deartpment, and for his services in that assignment was awarded the Legion of Merit with the following citation:

"For exceptionally meritorious conduct in the performance of outstanding services to the Government of the United States as Head of the Material Branch in the Bureau of Ships from April 3, 1944, to October 15, 1945."

On February 21, 1947, Captain Dowd was ordered to duty as Commander, U. S. Naval Shipyard, Mare Island, California.

The Mare Island Naval Shipyard

The Electronics Office

By Geo. K. O'Hara

■ The history of the Electronics Organization at the Mare Island Naval Shipyard will, when it is written, make an interesting, instructive and enlightening story. It is a story of pioneering and achievement, of constant advancement and of progress over a period of almost fifty years of Naval history.

This issue of Electron *brings to its readers the inside story of the Mare Island Naval Shipyard and some of the affiliated activities. This is the story of a great Naval base which has served the forces ashore and afloat for many years and in many ways. It is an interesting story, prepared in its several parts by the same people who contribute their skills and energies to the everyday fulfillment of the Yard's broad responsibilities.*

The Electronics Office of this shipyard is organized in accordance with standard Naval shipyard regulations, is under the direct supervision of the Electronics Officer and performs many separate functions in carrying out its portion of the mission of the shipyard.

Captain Joseph B. Berkley, U.S.N.

The Electronics Officer

Captain Joseph B. Berkley graduated from the U. S. Naval Academy in 1929. Shortly before the start of the last war he served with the Yangtze Patrol gunboats in Japanese-controlled waters of China. Later, as Commanding Officer of the USS Tulsa, he succeeded in saving his ship by evading the overpowering Japanese forces in the Far East. He served on the famous South Dakota in her actions in the battles of Santa Cruz, Guadalcanal, the campaigns in the Marshalls and Gilberts, and the raids on Nauru and Truk.

Captain Berkley is a graduate of the Post Graduate School in Electronics. He assumed the duties of the Electronics Officer at the Mare Island Naval Shipyard on 5 February, 1948, relieving Captain A. L. Becker, who is now the Assistant Chief of the Bureau for Electronics. Prior to his present assignment, Captain Berkley was head of the Design Branch of the Bureau of Ships Electronics Division.

THE ELECTRONICS OFFICER
Capt. J. B. Berkley, USN

The Electronics Officer is responsible to the Shipyard Commander for the proper functioning of his office, advises and assists him in all matters pertaining to electronics work, supervises field work at all Twelfth Naval District electronic activities, regular and reserve, is responsible for technical control and inspection of electronics work and for maintenance of shore radio, radar, sonar and other electronics activities in the Twelfth Naval District. He maintains liaison with all Naval and commercial electronics activities in the area.

He acts as Deputy Shipyard Commander in all matters pertaining to District electronic activities.

As Deputy Planning and Deputy Production Officer, he has supervision over all electronics work in the Planning and Production Departments.

THE ASSISTANT ELECTRONICS OFFICER FOR SHORE
Lieutenant Commander R. D. Lagle, USN

The Assistant Electronics Officer for Shore is responsible to the Electronics Officer for preliminary design, development, installation and maintenance of all shore electronics activities in the Twelfth Naval District. He maintains liaison with the Commanding Officer, Navy Communication Stations, Twelfth Naval District, and with officers-in-charge of all district communication stations and electronic activities. He acts for the Electronics Officer in the absence of that official.

THE DISTRICT RESERVE ELECTRONICS OFFICER

The District Reserve Electronics Officer reports under additional duty orders to the Electronics Officer and is assigned to investigate and report on all problems which arise in connection with Twelfth Naval District reserve electronics activities. He is responsible for the maintenance of equipment records and installation priority schedules. He maintains liaison with all Twelfth Naval District reserve electronic activities and with reserve training organizations.

THE SENIOR CIVILIAN ASSISTANT
Mr. Geo. K. O'Hara

The Senior Civilian Assistant directs and coordinates the work of all sections, groups and units of the office, maintains liaison with all heads of departments, divisions and offices of the shipyard and with district electronic activities. He advises and assists the Electronics Officer and maintains technical and management control over all activities of the Office.

Senior Electronics Engineer

Mr. George K. O'Hara, the Chief Civilian Assistant to the Electronics Officer, has been employed in electronics work at the Mare Island Naval Shipyard since 1904. His name has come to be synonymous with the growth of electronics from the days of the early, elementary wireless to the present day of highly-technical, war-winning equipment and technique.

Mr. O'Hara will never be forgotten as the man who took such an active, responsible part in the building of the network of early wireless telegraph stations on the Pacific coast and in Alaska. More recently he has taken a like part in the establishment of the new Electronics Shop (Shop 67) at the Mare Island Naval Shipyard. He is and will long continue to be a mainstay in this highly-integrated, technical organization.

Mr. Geo. K. O'Hara

SECTIONS

The Electronics Office is divided into three general Sections; Technical, Inspection and Clerical. The Head of the Technical Section is the Chief Engineer. He directs and coordinates the efforts of all engineers for the long range planning of all engineering problems affecting electronic activities in the Twelfth Naval District. He reviews and approves plans, specifications, reports, procedures and correspondence pertaining to electronic engineering subjects. The Head of the Inspection Section is the Chief Inspector for the office. He supervises and directs all technical inspection work, advises the office on technical aspects of all electronics work performed in shipyard shops and on board ships. He maintains liaison with Assistant Repair and Assistant Shop Superintendents for Electronics.

The Head of the Clerical Section is the Chief Clerk for the Electronics Office. The Chief Clerk supervises and directs the work of all clerical employees, acts as personnel assistant and furnishes clerical services for all sections, groups and units of the Electronics Office.

GROUP ORGANIZATION

The Technical and Inspection Sections are each divided into four groups. Under the Technical Section there is an Installation and Maintenance, Progress Control, Ships Test and an Engineering Group. The Installation and Maintenance Group is responsible for the installation and maintenance of all shore radio, radar, sonar and other electronic equipment at shore electronic activities in the Twelfth Naval District, regular and reserve. They establish suitable schedules of maintenance by station force or shipyard personnel as required, make inspections and test, calibrate and adjust installed equipment. The Progress Control Group maintains liaison with officers-in-charge of district electronic activities, arranges priority of work, directs the initiation of job orders, prepares correspondence and maintains progress control records. The Ships Test Group performs all necessary tests, calibrations and engineering measurements on shipboard radio, radar, sonar, teletype and other electronic installations. They supervise the work of contract engineers, provide engineering information and data to shipyard shops and other shipyard branches as required. They provide engineering services for all GCA units installed in the Twelfth Naval District or undergoing overhaul on the shipyard, and perform special engineering work as assigned. The Engineering Group is responsible for the preliminary planning, development, engineering and design of all shore radio, radar, sonar, teletype and other electronic installations in the Twelfth Naval District. They supervise the preparation of plans and specifications, provide engineering data and act as technical engineering consultant on all shore station problems.

Under the Inspection Section there are four groups, Radio and Teletype; Technical Data; Sonar and Radar Group. The Technical Data Group maintains an extensive working file of instruction books, plans, technical publications, text books and technical data. They furnish technical data to sections, groups, units and other shipyard activities as required. The Radio and Teletype, Sonar and Radar Groups perform identical functions in their respective fields. They prepare data for arrival conference reports, inspect work, make tests and furnish technical data and information to planners, design engineers and shop supervisors.

INDEPENDENT UNITS

Working jointly under the Head of the Installation and Maintenance and the Head of the Engineering Groups are eight units. Three cover district-wide activities and five are assigned to important communication stations. The Internal Security and Industrial Control Unit is responsible for the engineering, installation and maintenance of a District-wide system of two-way f-m voice communication circuits involving many fixed and mobile stations. The Teletype Unit is responsible for the engineering, installation and maintenance of a district-wide system of teletypewriters, NTX, radio and local loops. The Lines, Cable, CCL and Terminal Unit is responsible for the systems engineering of all intra-district lines, cables, v-h-f links and associated terminal equipment used for control of radio transmitters and receivers. Units are assigned to each of the following listed activities: Navy Communication Stations, Mare Island, San Francisco, Dixon, Skaggs Island and N.A.S. Alameda-Moffett Field. The functions of each of the five units are identical but work performed varies with the size and importance of the station to which the unit is assigned. The head of each unit is designated as the Station Engineer. He is the Electronics Officer's representative and technical advisor to the Commanding Officer and the Officer-in-Charge of the station to which assigned. He supervises the installation and maintenance of all equipment and coordinates planning, design and standards for his station.

The Electronics Shop

By H. W. Pratt and Edgar Case

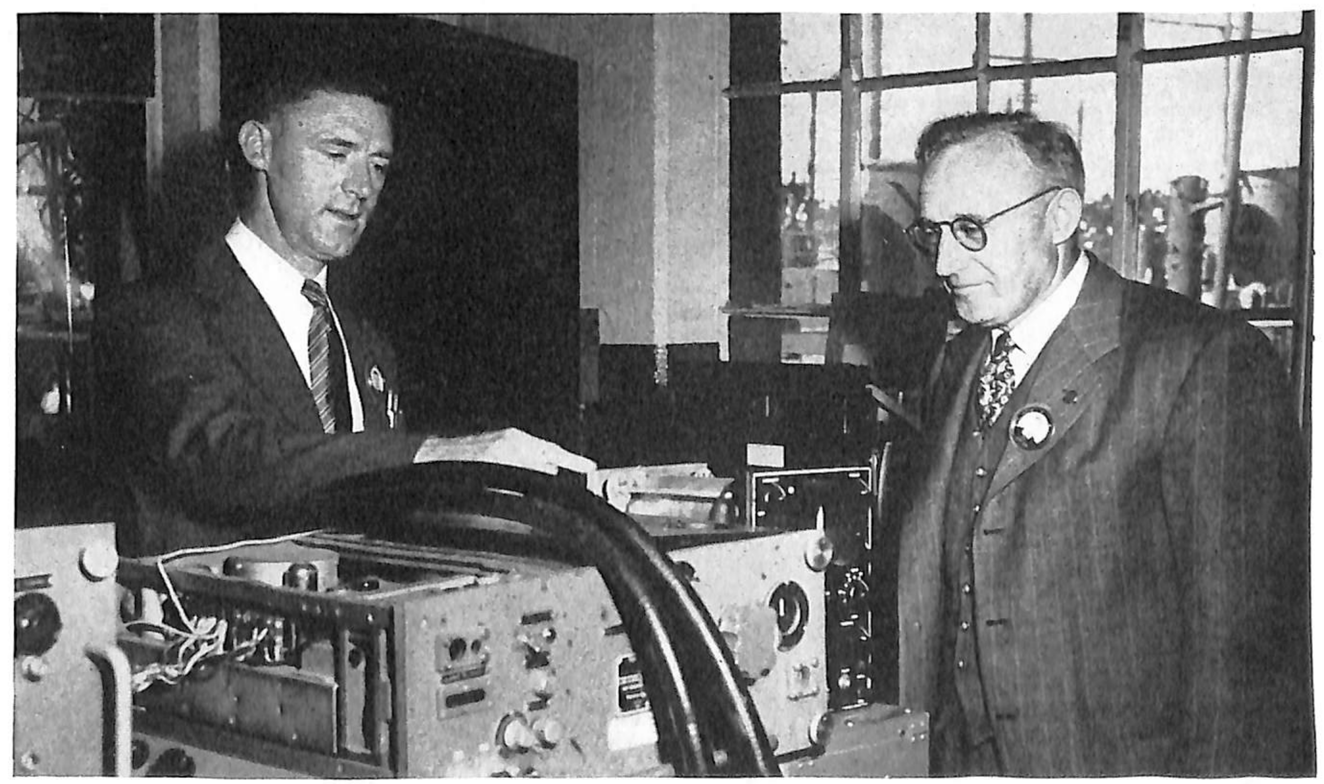
■ The Electronics Shop (Shop 67) has been established under the Production Department, Shop Superintendent's Office, since March of this year. Shop 67 is headed by a Chief Quarterman Radio Mechanic who is acting as Shop Master until a new master is appointed. Under the Acting Master are 5 quartermen, 20 leadingmen, 301 artisans, 178 helpers and 22 apprentices, making a grand total of 526 persons employed in this shop. Because of the existing heavy workload incident to the tremendous Electronics Rehabilitation Program, it has been necessary to obtain additional workers to complete the immense amount of work involved. The normal shop force is at present augmented by 100 additional employees borrowed from other production shops. This further increases the present working force of 626 employees. Another article in this issue covers the rehabilitation program.

The transition to shop status was accomplished with a minimum of confusion since it was mainly a change in name: from Electronics Facility to Electronics Shop (Shop 67). Little change in policy or procedure was necessary as the Electronics Facility had always done the work of a shop without official shop status.

Work accomplished by Shop 67 is divided among groups with supervisors in charge of each section.

TELETYPE & CRF SECTION

This section accomplishes all teletype and CRF overhaul, installations and maintenance work in the Twelfth Naval District. This shop, besides having facilities for complete overhaul and reconditioning of teletype and CRF equipment, has a



Quarterman R. G. Bauman and Chief Quarterman H. W. Pratt, Acting Master

A portion of the Crystal Finishing Section of Shop 67.

mobile repair unit for routine maintenance in the field.

INTSRUMENT REPAIR SECTION

The Electronic Instrument Repair Shop is conveniently arranged and completely equipped for repairing and calibrating all types of electronic instruments, including frequency meters and calibrators, tube testers and analyzers, vacuum tube meters, capacity resistance and impedance bridges. Key employees are receiving special training in the repair and calibration of radiac instruments.

CRYSTAL GRINDING SECTION

Within Shop 67 is located one of the three major Navy crystal grinding activities. Others are at Pearl Harbor and at the Naval Gun Factory, Washington, D. C. Since the establishment of this section in November 1945, approximately 150,000 type CR-7 crystals for TDZ/RDZ u-h-f equipments have been tested for activity and frequency tolerance. This was accomplished under BuShips Project Order #320/47. Equipment installed in the Crystal Section includes a primary frequency standard, six finishing and test positions, lapping machines, etching tanks, and many other items. Additional modern new equipment is under procurement. Equipment available is capable of manufacturing crystals of all types used by the Navy excepting primary bars, plated types and hermetically sealed units.

RADAR, RCM, IFF AND LORAN

Approximately 7,000 square feet of floor space are devoted to the repairing of radar transmitters and receivers of all types, including radar countermeasures, IFF, and loran equipments. Specially-constructed test racks are widely used. Wave guides and coaxial lines run to roof antennas to conduct tests under actual conditions. Loran, sensitive receivers, and frequency meters are tested in a double-copper-mesh screened room to eliminate external interference.

INFRA REPAIR SECTION

This section (formerly Nancy Repair Facility) was established in July 1946. Mare Island and Norfolk are the two such Naval activities in the United States. This shop is equipped with benches, test equipment, test panels, collimators, a gassing unit and a dark room for threshold and resolution tests.

RADIO RECEIVER SECTION

The Radio Receiver Section repairs all types of Navy radio receivers and direction finders for ship and shore radio stations.

RADIO TRANSMITTER SECTION

This section is concerned with the repair and testing of all types of Navy communication transmitters, large and small, covering the spectrum from v-l-f to u-h-f. If necessary, transmitters are completely dismantled to the smallest component and completely rebuilt and refinished.

OUTSIDE SHOP

An outside section of Shop 67 with a Quarterman and Leadingman in charge has been organized. This section is engaged in the removal and installation of electronic equipment on shipboard as well as accomplishing shipboard electronic repairs.

SHORE STATIONS

The Shore Station group consists of a quarterman, 5 leadingmen, 40 mechanics and 20 riggers and helpers. This unit accomplishes electronics maintenance work at all shore based radio stations in the entire Twelfth Naval District, including all installation and maintenance work incident to the Internal Security Network of some 600 stations.

GROUND CONTROL APPROACH REPAIR SECTION

Shop 67 personnel under the direction of an electronics engineer accomplishes overhaul of GCA equipment from all areas west of the Mississippi River, including the Pacific Ocean Area. This activity is described in more detail in another article.

MANUFACTURING SECTION

This section is a complete machine shop, set up for light manufacturing work incident to the repair and installation of electronic equipment. Parts that cannot be procured from commercial sources are manufactured in this section. Fabrication and assembly of complete units is often necessary.

APPRENTICE TRAINING

Twenty-two apprentices are completing their studies in trade theory and experience in shop practices. The first group will graduate in about eighteen months from this writing and will take their places as full-fledged artisans in the shop and on board ships.

SONAR AND TRANSDUCER REPAIR SECTION

This section repairs, tests, and provides maintenance for sonar equipment installed in Naval vessels and at harbor installations. Facilities are provided for cleaning, dismantling and assembling transducers. Air vacuum pumps, spray booth, compressed air paint spraying equipment, test tank, machine shop and stowage space are included.

Radio Receiver and V-H-F/U-H-F Transmitter Section.

Twelfth Naval District Shore Communication Stations

By G. W. Cattell

■ The part played by the Twelfth Naval District in the story of shore wireless stations on the Pacific coast is long and full of interest. Mare Island had a hand in the erecting and outfitting of most of the early stations in the Eleventh, Twelfth and Thirteenth Naval Districts and in Alaska.

The first Navy wireless station on Mare Island was a combined transmitting and receiving station consisting of a Slaby Arco open gap spark transmitter together with a Slaby Arco coherer and decoherer for receiving.

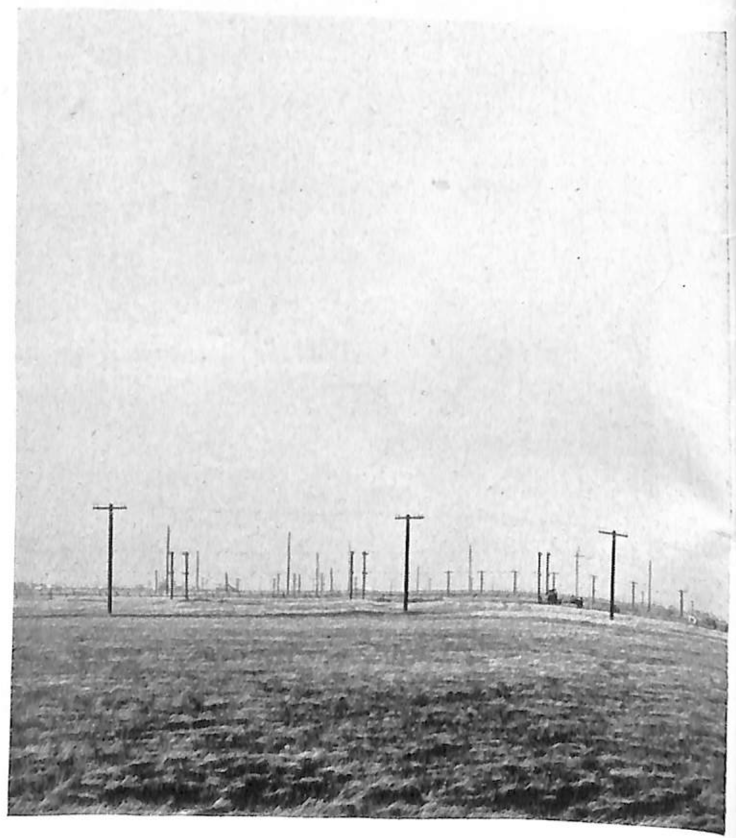
The station was commissioned 21 May 1904. The first message was transmitted to Yerba Buena, approximately twenty air miles distant, by R. B. Stewart now the Senior Electronics Engineer in the Office of the Electronics Officer, Eleventh Naval District. The message was received by a Mr. Carroll, present whereabouts unknown.

In 1921 the Navy established a series of radio direction finder stations along the West Coast. Mare Island originally maintained all the traffic and direction finder stations in the Eleventh and Twelfth Naval Districts and in Alaska and some of the stations in the Thirteenth Naval District. In 1921 the Thirteenth Naval District assumed the maintenance for all stations in that district and in Alaska. In 1924 the Eleventh Naval District assumed the maintenance for their own stations.

About 1920 the Navy started the construction of a series of low-frequency, high-power arc transmitting stations for broadcast schedules to the fleet and for daylight transcontinental and trans-Pacific point-to-point circuits such as Washington, Honolulu, Cavite and Balboa. The Mare Island station was commissioned in 1921 with a 60 kw arc converter with an antenna supported by three 450-foot self-supporting steel towers spaced at the corners of a 1,000-foot triangle.

The method of signalling was to alter frequency slightly, the difference between "mark" and "space" being on the order of between 100 and 500 cycles. Full advantages of this type of frequency shift keying were not fully appreciated. Walter Fanning of the Twelfth Naval District applied for a patent however, utilizing the principle of using the marking and spacing waves to operate a common polar relay. It was used only to a limited extent.

One of the troublesome disadvantages of the arc transmitter is that it is an inherent generator of severe radio interference covering a continuous band of frequencies from the fundamental upwards. This was known as "arc mush." About 1922 the Federal Telegraph Company, the principal manufacturer of arc converters, invented the nodal-point system of keying which eliminated the spac-

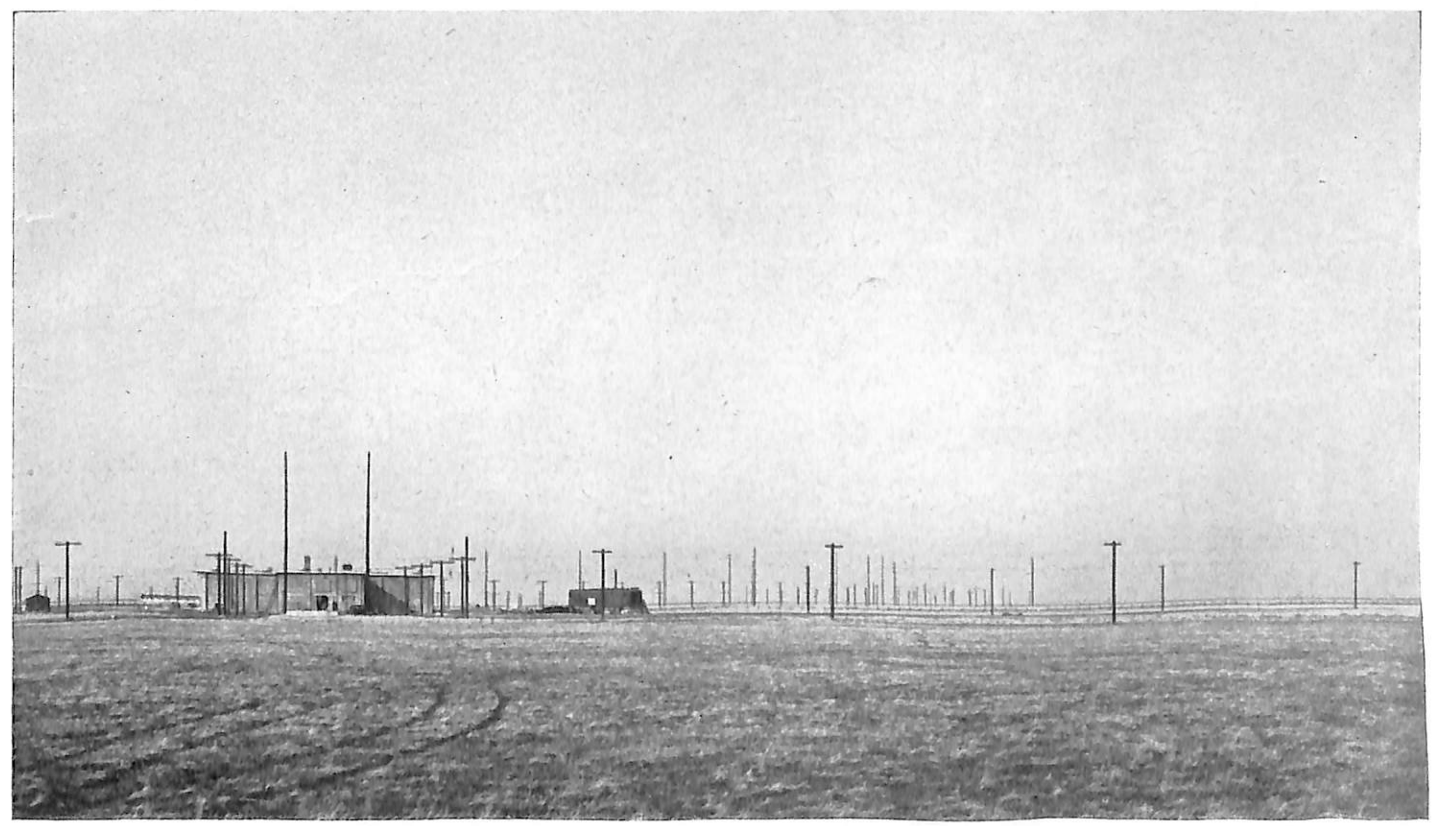


The Mare Island station as it appeared in 1904.

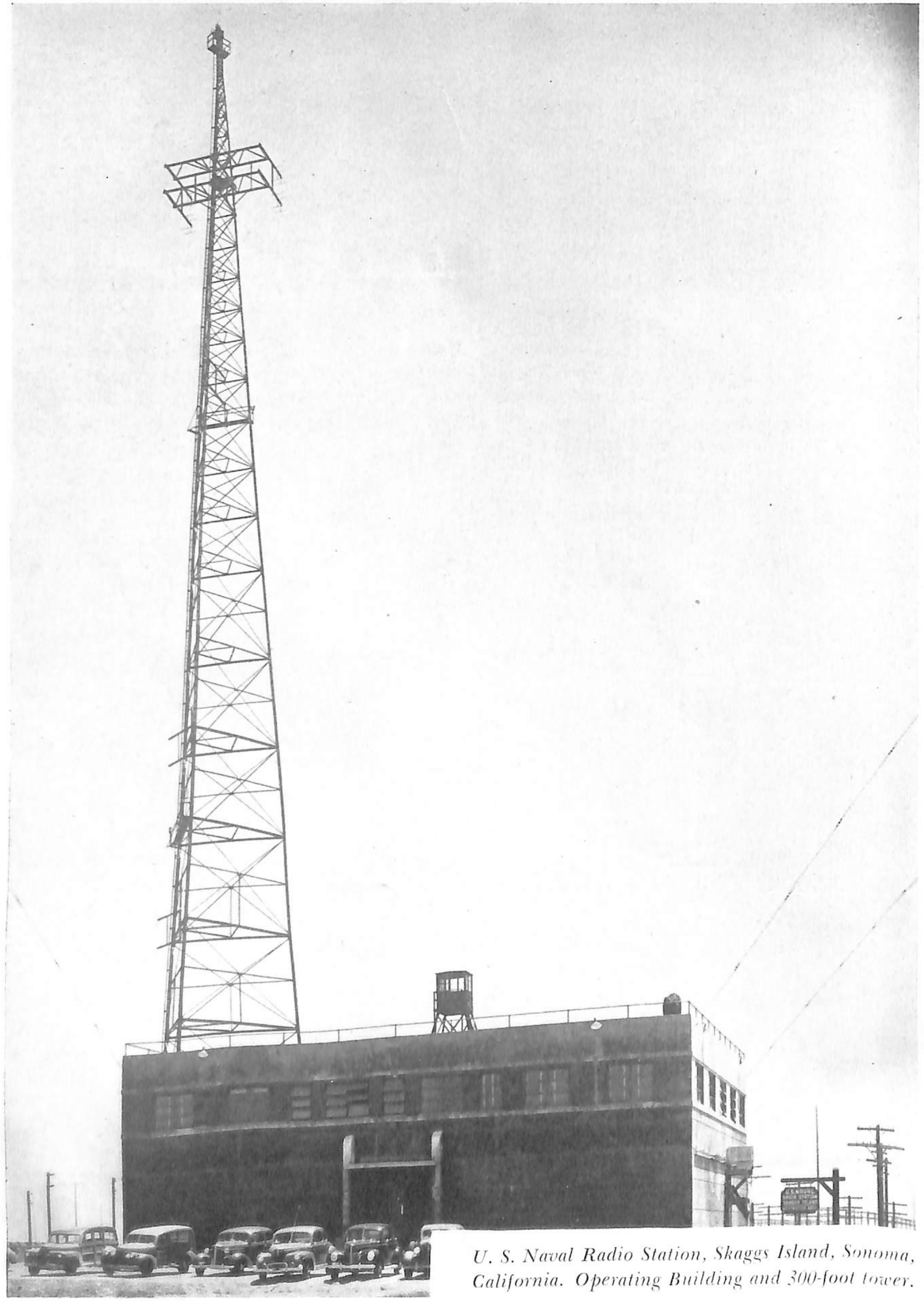
ing wave and effectively reduced the arc mush near the fundamental frequency and to a lesser degree at higher frequencies. About the time radio broadcasting became popular, the Navy became very unpopular for the intense arc mush interference its arc transmitters were causing. Twelfth Naval District personnel developed a low pass filter which when used in connection with suitable shielding was found very effective in reducing arc mush interference on broadcast frequencies to a value where there were no further complaints. This circuit was successfully used by other Navy stations as well as some commercial installations.

Mare Island personnel designed and built the Navy's first monitor receiving system which was installed at the South San Francisco Radio Station where receiving conditions were good. The signals were "piped" into the control station in San Francisco over wire lines leased from the telephone company. Although this method met with some opposition initially its merit was soon recognized and other installations followed.

Then came the "discovery" of high frequency communication. Isolated cases of very long distance communication using very small power gave rise to many false hopes that it might become the usual thing. It was soon realized that considerable power would be required to obtain thoroughly dependable



U. S. Naval Communication Station, Dixon, California. Transmitter Building.



U. S. Naval Radio Station, Skaggs Island, Sonoma, California. Operating Building and 300-foot tower.

results. However, the many advantages of high-frequency communications were soon appreciated and stations sprang up all over the world. New and more-efficient antennas were developed which required larger receiving station sites. The Twelfth Naval District's high frequency receiving developments were transferred to Mare Island, using the same site on the hill which was used for the original Mare Island station. Fading was one of the most troublesome vagaries of high-frequency transmissions. The problem is now understood and effective remedies are available. As the Navy is concerned, Mare Island personnel pioneered diversity reception. Mare Island installed what probably was the first rhombic and certainly the first multiple-wire rhombic receiving antennas used in the Naval Communication Service. Mare Island is believed to be the first to rebroadcast time signals and the first to make practical use of rebroadcasting of traffic by acting as an automatic relay station between Radio Washington and Radio Honolulu. The Twelfth Naval District also pioneered the Navy's use of high-speed Boehme automatic tape transmission and reception.

In the meantime, several high-frequency transmitters had been installed in the High Power station. Because the Hill Receiving Station was only one-mile distant from the High Power transmitting station, the problem of "key clicks" was quite troublesome. Twelfth Naval District personnel satisfactorily solved this problem by developing a diversity-mixer unit incorporating a new circuit which proved effective in eliminating key clicks and all other interference of the impulse type.

Mare Island and the Twelfth Naval District have a tradition of which they are justly proud: whatever it is, it *can* be done; no effort is too great, individual cerdit is not a motivating factor, and that we all work together on all occasions. Everyone is a member of the same team. Mr. George K. O'Hara, Senior Civilian Assistant to the Electronics Officer, and who has been with this yard for forty years, has played an important role in developing this *esprit de corps*.

ACTIVE INSTALLATIONS, TWELFTH NAVAL DISTRICT

To name and describe all the presently active shore electronic activities in the Twelfth Naval District would be beyond the scope of this article. Only a few of the major activities will be discussed briefly.

NCS Skaggs Island—Navy Communication Station, Skaggs Island, houses three activities: 1—Receiving Activity, 2—Communications Supplementary Activity and 3—Security Activity. The reservation consists of 3,300 acres of flat and level land surrounded by salt water sloughs and protected therefrom with suitable levees. It is approximately 28 air miles (49 road miles) from the San Francisco Control Station and 8 air miles (29 road miles) from Mare Island Naval Shipyard. The quarters and station maintenance facilities area is in the northeastern corner. The main operating building is located near the geometric center.

The main operating building is of reinforced concrete measuring 80′ x 85′ and consists of two floors and a basement. It is of splinter-proof construction with no windows below the second floor. It was originally designed and equipped to be a combined major diversity receiving station and complete emergency control station. The lower floor was intended for operating activities. Each room therein is completely shielded with sheet copper. The basement was intended for wireways, conduits and other services. The second floor was intended for offices, storerooms and air conditioning equipment.

The 80′ x 30′ receiving room was designed to accommodate four rows of single or diversity receivers. The supervisor's desk, audio, radio frequency and power panels as well as the two crystal controlled clocks are located at one end of the room. At the other end of the room are located emergency Boehme positions and ships operating table. Because experience has indicated that it is expedient to have the ship-to-shore operators situated where they can control their own receivers, ships tables (where manual and radio-teletype operators handle this type of circuit) are located adjacent to the wall originally intended for the fourth row of receivers. Receivers and ships tables are above rows of concealed prefabricated holes in the floor which convey wires and cables to a three-tier cable tray slightly to one side of the holes.

The Communication Supplementary Activity occupies the 80′ x 35′ room originally equipped for control purposes. This activity also occupies additional operating space on the second floor. This activity has sole occupancy of the Special Project Building surrounded by 19 rhombic antennas and the DAJ building which are remotely located. Additions are in the planning stage.

The Security Activity occupies space on the second floor. It is well equipped with a model LAM precision frequency measuring equipment as well as other necessary facilities to measure quickly and accurately any received frequency from the very low to ultra high. Facilities permit of monitoring several types of transmission including teletype to assist in its program to observe any irregularities in procedure.

The main antenna system consists of three spaced rosette groups of rhombics. Each of three groups was originally of slightly differing design: a—single-wire horizontal, b—3-wire horizontal, and c—single-wire sloping. The intention was to service-test the three types to determine the best. The 3-wire type appears to be most satisfactory.

NCS Mare Island—Mare Island is the site for both the Low Frequency Station and the new High Frequency Transmitting Station.

Low Frequency Transmitting Station—The original High Power Station was built in 1920 and originally housed one 60 kw arc. During the years that followed, several more arcs were added which in turn were replaced by tube transmitters of various types and descriptions. The two major arcs (100 kw input) were used on frequencies of 28.5 and 42.8 kc up to 1942 when they were replaced by tube transmitters. In the meantime, many high-frequency transmitters were also installed until it was quite apparent that additional space would be required to house the evergrowing number and size of high-frequency transmitters. This station is remotely controlled and essentially unattended, being visited about once per watch.

High Frequency Transmitting Station—The High Frequency Station was commissioned in 1940. It is cross-shaped, built of reinforced concrete and having three operating wings and an administrative wing. A splinter-proof operating booth is located at the intersection of the three operating wings. From this booth may be started, stopped, keyed and monitored, any transmitter including those located at the Low Frequency Station one mile away. The transmitters are arranged in four rows and rest over concealed prefabricated holes in the floor which permit the wires and cables to pass into the three-tier wiring trays which follow along beside but under the holes. A three phase enclosed power bus forms a loop circuit entering the three wings. Power taps as heavy as 600 amperes may be taken off every 22 inches without danger to personnel and without interrupting the circuit.

NCS, Dixon, California—The high-frequency transmitting station at Dixon is not yet in commission. The station is located approximately 54 air miles (72 miles by road) from San Francisco and approximately 33 air miles (42 miles by road) from Mare Island. It occupies two adjoining sections (1280 acres) of flat and essentially-level land. The entrance is at the north end. The operating building is situated near the geometric center of the property, one mile to the south.

U. S. Naval Radio Control Station, San Francisco. Teletype Relay Center Tape Monitors.

The station was originally intended to be the major high-frequency station in this area. Because of the many changes which have taken place since then, its present status is that of supplementing the High Frequency Transmitting Station at Mare Island. It is understood that the Dixon station will be used, among other purposes, as an experimental station to service-test new ideas such as the development of an unattended, completely remote-controlled transmitting station. Because of the large land area available, it is probable that some antenna development will also be undertaken.

The main features of the operating building are of BuShips design. The building is essentially "tee"-shaped with a small administrative section in front. The transmitter room, approximately 38′ x 122′, was designed to accommodate ten transmitters.

No specific space has been assigned for additional transmitters other than that now being used as a shop and a relatively small storeroom, which could be made available by the removal of certain partitions. The station is completely air-conditioned to take care of the heat dissipated by the air-cooled transmitters and the excessive temperatures which prevail during the summer months. The floor in the main transmitting room and all administrative areas is of terrazzo construction. Floor trenches are used for electric wiring and cooling water. The main air-conditioning ducts are also in the floor with gratings to allow the flow of cooled air. If appreciable further expansion is deemed necessary, the Bureau has proposed the building of an extension on the other end of the "tee" and construct another transmitter room similar to the one now housing the present transmitters.

There are at least two new and interesting features connected with the Dixon installation. The first twin-rhombic antennas in this area have been constructed at this station. It will be very interesting and instructive to compare them with the standard rhombic and to test the feasibility of using the two halves as separate antennas or the possibilities of horizontal beam steering or beam width control by adjusting the phase relation in the two halves. The two halves of the twin have been brought over separate transmission lines into the building to obtain greater flexibility of utility as well as for greater ease in experimentation. Great care has been taken to keep the transmission lines feeding the two halves as nearly alike as possible

Another feature which will be tried out is a new system of very flexible radio frequency switching between antennas and transmitters. These switching facilities will comprise two banks of overhead switch units filling a large portion of the space between opposing rows of transmitters. The new system attempts to approximate the ideal of being able to place any transmitter on any antenna without danger to personnel.

The main power is furnished by the Pacific Gas and Electric Company at 60,000 volts. It passes through Company-owned transformers and Navy-owned switch gear at 2400 volts and then through underground ducts to the operating building about one mile distant. Emergency power is furnished by a 600-kw advance-base-type Diesel engine generator which delivers power through suitable switch gear at 2400 volts.

The antenna field consists of seven twin rhombics and eight single rhombics. Number 6 copperweld wire spaced 12 inches apart is used for outside transmission lines. The same size wire spaced 6 inches apart is used for transmission lines inside the operating building.

NCS San Francisco—The San Francisco Control and Teletype Relay stations are located in the Federal Office Building near the San Francisco Civic Center. The radio control room and teletype relay center are located on the third floor. The model UN and single-sideband terminal equipment as well as the two model TDO transmitters are located on the sixth floor. A 150 kw Diesel engine set in the basement furnishes power in case of emergency.

The NTX and radio teletype relay center are considered the best and most efficient in the Naval service. The present arrangement with all its facilities is the result of progressive improvements and a creative imagination.

Some facilities for Boehme transmissions are still being preserved for sending of FOX schedules or where otherwise required.

The radiophoto facilities for the district are located on the sixth floor. Many now famous World War II pictures came over this circuit.

Mare Island transmitters may be controlled from the control station over land lines leased from the Pacific Telephone and Telegraph Company or over the v-h-f communication control links. The radio signals received at the receiving station at Skaggs Island may similarly be transmitted to the control station over the v-h-f communication control links or over Navy-owned cables between Skaggs Island and Mare Island and thence over leased lines to San Francisco. Arrangements have not been completed to permit the use of multi-channel operation over land lines leased from the telephone company.

The ZEBRA Program of Rehabilitation

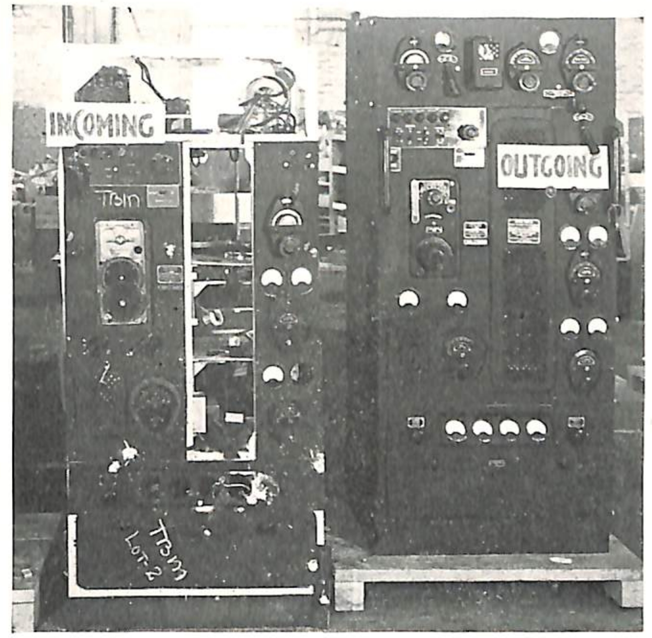
By Harry F. Bird

■ Toward the end of the war, Mare Island, like other shipyards, had the problem of handling and disposing of obsolescent electronic equipments turned in by ships and stations. Under the joint control of the Electronics Officer and the Supply Officer, a Salvage Unit was established to segregate the miscellaneous gear so that it could be identified and made readily accessible. During the final stages of the war, this Salvage Unit was often the sole source of electronic units and replacement parts which were not available in stock spares. The cessation of hostilities stopped shipments enroute to bases. Orders to return the material to the Pacific Coast threw supply lines into reverse. Mare Island seemed to be a logical place for roll-up material since manpower and facilities were still available. In order to alleviate shipping bottlenecks in the San Francisco Area, returning ships were ordered to Mare Island by Commander, Western Sea Frontier. Admiral Klein, Shipyard Commander, and Captain Becker, the Electronics Officer, anticipated the tremendous amount of work involved in handling this material. One of the largest buildings on the shipyard, having overhead cranes, was assigned as the Electronics Reutilization Plant.

The diversion of roll-up material to Mare Island was a local arrangement to meet local logistic problems. Other Naval activities in the Western Sea Frontier faced the same problem. Commander, Western Sea Frontier and the shipyard commander urged the official designation of the Electronics Reutilization Plant (ERUPT) as the central processing point for all roll-up electronic material on the West Coast in order to conserve funds and manpower. Admiral Mills of the Bureau of Ships visited Mare Island early in 1946 for an inspection of the work and facilities for handling electronic material piled up in other shipyards, supply depots and the forward area. The Electronics Reutilization Plant was officially designated in August 1946 to process all equipment received from Western Sea Frontier.

Many thousands of feet of floor space are devoted to the ZEBRA *program. Shown here is the main assembly room.*

In January 1947, the Bureau of Ships advised Mare Island concerning the exact disposition of the various types of electronic equipments. As the boxes were opened, equipments were visually inspected to determine their condition. All those determined to be beyond economical repair due to physical damage were turned over to the Supply Officer for disposal as scrap-salvage. The "critical" equipments were reported to BuShips for disposition (Category A). Equipments which the Bureau designated as being "required for stock" (Category B) were turned over to the Supply Department for storage by lot numbers at N.S.A. Stockton, California, for eventual overhaul under Project ZEBRA. Equipments for which BuShips had no further requirements were turned over to BuPers for the Naval Reserve Program or sold as surplus by War Assets and the local Supply Officer. During ERUPT operations, spare parts were set aside in anticipation of the eventual overhaul needs and the Bureau's Shipboard Spare Parts Program. These spare parts boxes have been segregated by types. Some are being broken down and binned by Mare Island, some by Oakland. Spares for Category C and surplus equipments are stored at Stockton.



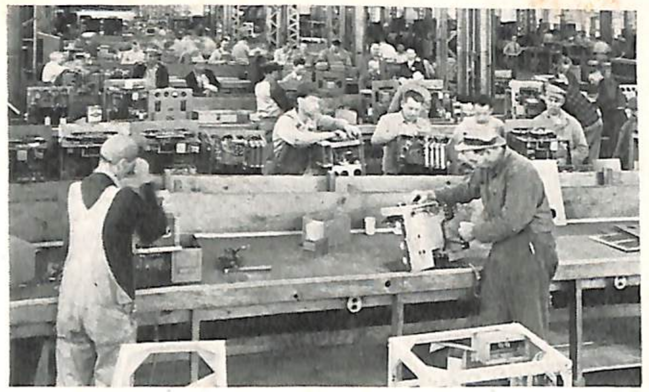
At left, a transmitter as received for repair. At right, a similar transmitter after being exposed to the ZEBRA *program.*

To determine the amount of work under Project ZEBRA, it is necessary to define the lot unit. A lot is composed of the Navy Type Units that make up a given type of equipment. As an example, ZEBRA Lot 147 having 550 units should produce about 550 RBO receivers, while Lot 202 having 4,000 units may produce only 400 SO-series radars. There remain about 46,000 units to be rehabilitated under Project ZEBRA. The total cost of rehabilitation is estimated at about $2,500,000, and should return to BuShips stock or use approximately $30,000,000 worth of electronic equipment. As the units are restored to practically new condition, they are assembled into complete equipments, inspected and assigned new serial numbers prefixed with the shipyard symbol, i.e.: RM for Mare Island or RS for Puget Sound.

A Bureau of Ships allocation of ZEBRA work has been made to Puget Sound Naval Shipyard. Tentative assignment of specific equipments for rehabilitation by Puget Sound Naval Shipyard has been made. Mare Island divides the remaining work with San Francisco Naval Shipyard in order to expedite the program and utilize available manpower. Work schedules are based on priority assignments made by BuShips and production output. As the needs of the Bureau change, lot rehabilitation schedules will be altered as necessary. Mare Island has been designated by BuShips to coordinate the ZEBRA project on the West Coast. Based on monthly reports, the Bureau, by shipment order, disposes of the equipments as they are turned in to the Supply Officer after rehabilitation.

At Mare Island, the ZEBRA program is designed to operate on a production line basis. When an equipment consists of several types of component units, all of the units are processed separately and assembled into complete systems as they come off the lines. Each unit is thoroughly cleaned, painted or plated as required, and tested. Disassembly is kept to a minimum. The ZEBRA building of Shop 67 is divided into bays, each of which is under the supervision of an electronics mechanic. The personnel are for the most part unskilled in electronics but following the lead of the electronics mechanic are able to perform the routine tasks of cleaning and painting. All tubes are tested, defective or damaged parts replaced and available field changes made. At the end of the lines, a complete operating equipment or "jig" is set up to permit rapid testing. As each unit reaches the end of the line it is put into operation for inspection. The assembled equipment is then packed and shipped.

Since the Naval Reserve material requirements are now the responsibility of BuShips, the ZEBRA output will be used to fill Naval Reserve allowances



Part of the ZEBRA *production line.*

where necessary. It is expected that some of the ex-BuPers electronic equipments now under BuShips will be rehabilitated under the ZEBRA project. The results to date indicate the tremendous value of the ERUPT and ZEBRA projects. Approximately 61 million dollars of electronics equipments and components have been saved for future requirements. Over 1,000 equipments and major components have been rehabilitated and returned to stock.

SU/SU-1 COAXIAL CONNECTORS

When the control and range unit of the Models SU and SU-1 Radar Equipments is removed from a ship for shop repairs, certain plugs must be cut off the video and trigger coaxial cables in order that the cables can be pulled through the entrance cable clamps. This often makes it necessary to replace entire lengths of cable when the unit is put back in place and reconnected. In most cases, Plugs and Jacks 501, 503, 505, 506 and 507, Navy Type Number NT-49195, are involved since they are located inside the control and range unit and their associated cables enter through the cable clamp.

To remedy this condition, the Puget Sound Naval Shipyard has found it desirable to cut these coaxial cables external to the unit, and insert a 1-foot jumper with an added set of coaxial plugs and jacks. The external plugs and jacks make it easier to remove and replace the control and range unit for servicing in the repair shop. They eliminate the necessity of installing five or six new plugs inside the unit each time it is removed for repair, and they also prevent the replacement of long lengths of coaxial cable in many cases. Because of these advantages, the Bureau of Ships has approved this Puget Sound Naval Shipyard suggestion, and recommends that it be used whenever a model SU or SU-1 control and range unit is to be removed for servicing.

High-Voltage Measurement . . . . .

The policy of the Electronics Division of the Bureau of Ships towards high-voltage measurements, as expressed in a memorandum dated 19 July 1946, was "to disapprove the measurement of voltages in excess of 1000 volts by means of flexible leads or probes and to disapprove the purchase, issuance and distribution of test equipment which will permit such measurements to be made." This policy has now been modified to extend the maximum limit from 1000 volts to 5000 volts.

This change in policy is due to the fact that adequate maintenance of many equipments designed under wartime conditions requires the measurement of voltages exceeding 1000 volts. In the design and procurement of test equipment for this purpose, however, all possible safety precautions will be taken by the Division to incorporate the maximum amount of safety possible, such as insuring adequate insulation of test leads, using suitable warning plates, etc.

In extending this limit from 1000 volts to 5000 volts, it is realized that this extension may seem inadequate, since future equipments may be designed using voltages in excess of 5000 volts. At present, however, there is no intention to increase this limit again, as the voltages in use increase. Instead, the difficulty will be resolved by other means. The specifications for future equipments employing potentials in excess of 1000 volts require that tests points for such potentials do not exceed 1000 volts (this can be accomplished through the use of voltage dividers) or that other techniques be employed, such as the use of safety type panel meters and multipliers which permit the measurement of higher voltages.

The instruction books for future equipments employing potentials in excess of 1000 volts will contain explicit information on the provisions incorporated in the equipment for measuring voltages above 1000 volts. This information will include complete data on the values of the individual components used in voltage divider or multiplier circuits, and tables showing the correct test point voltage values corresponding to the correct high-voltage values when the test point measurements are made with either a 1000 ohms-per-volt meter or a 20,000 ohms-per-volt meter.

—G. L.

Naval Reserve Electronics Warfare Program

By LT. COMDR. H. D. GIBSON, USNR (DREO)

■ The general BuShips policy governing Naval Reserve electronics places the responsibility for the procurement, distribution, and installation for all phases of the electronics warfare program in the Twelfth Naval District in the hands of the Electronics Officer, Mare Island Naval Shipyard.

Basic allowances have been authorized for each of the three types of electronic warfare installations. Components of the organized reserve utilize the facilities set up in the Naval Reserve training centers of which there are sixteen in the Twelfth Naval District. Companies meet in spaces designated as drill quarters, and platoons meet in spaces designated as stations. A quota of forty-five electronic warfare drill quarters and one hundred seventy-five electronic warfare stations has been assigned to the Twelfth Naval District.

As of June 1 nine training center buildings were complete and ready for installation of equipment. The remaining seven training centers are scheduled for completion within the year. Thirty-nine drill quarters and twenty-eight stations have been established and an initial distribution of equipment made.

The Naval Reserve training centers have been distributed throughout the district in accordance with the density of population. Three will be located in Colorado, two in Utah, one in Nevada, and ten in California. The distribution of drill quarters and stations is approximately the same.

Equipment had previously been accumulated and distributed under the direction of the Bureau of Naval Personnel. The Twelfth Naval District accumulated and distributed electronic equipment generated in the "roll back" program by ERUPT. Mare Island. Because Mare Island had a tremendous material handling and identifying problem, no attempt to assemble complete equipments for BuPers could be made. The Bureau of Ships and the Electronics Office are now correcting deficiencies in allowancs. Equipments are inspected, reconditioned and will be installed according to prepared schedules. Wiring diagrams and equipment layout plans have been prepared by the electronics staff, Mare Island Naval Shipyard, for completed training centers. As a statring point for planning purposes, a destroyer communications center has been chosen as a prototype. Variations are introduced to conform with the spaces and equipments available and to fit training purposes. Effort has been made to produce a plan simulating shipboard installation characteristics so far as possible, at the same time providing adequate space and accessibility for instruction and training.

Installation of the electronics equipment is accomplished by Mare Island installation teams and by reservists on extended training duty. Three installation engineers provided by Bureau of Ships contract with the Philco Corporation are of great assistance in this work. Installations at Naval Reserve training centers at Treasure Island and Vallejo, California, are representative of the work to be accomplished at each of the centers. Major equipments installed at Treasure Island include a TAJ, two TBK, and two TDE transmitters. At Vallejo the equipments installed include TBL, TBK, TCK and TDE transmitters.

To maintain interest in the Reserve Training program, temporary installations have been made wherever an activity had space for the purpose. These installations are accomplished by members of the organized or volunteer groups without expenditure of funds. This plan has made possible the participation of eleven training centers, thirty electronic warfare companies and nine electronic warfare stations in regularly scheduled communication drills.

Model OAH Code Practice Sets are on their way out. The Electronics Division does not intend to procure any more of them.

If you still have one, don't throw it away. If you do not have one, and need one, watch BUSHIPS ELECTRON *for an article giving instructions and wiring diagrams on how to build your own non-radiating set.*

Electronics at Naval Air Stations

By F. J. Maccono

■ The Electronics Office at Mare Island serves Naval Air Stations at Alameda, Moffett Field, Monterey, Oakland, California, and Buckley Field, Denver, Colorado. Equipment installed at these Stations includes facilities for radio communication, radio and radar aids to navigation, teletype communication and special electronic devices. Complete facilities are maintained for two-way radio communication on voice or c. w. for all activities requiring them, such as control tower operations; crash and emergency operations; station and operational communication; wing, carrier, group, and air transport service communications.

Tower operators control air traffic within a radius of fifteen miles as well as take-offs and landings by two-way voice radio. Several transmitting frequencies are available, usually one intermediate frequency (200 kc to 400 kc), several medium high frequencies (3000 kc to 7000 kc) and several very high frequencies (100 mc to 156 mc). These frequencies may be used individually or simultaneously by manipulation of selector switches at the operating console. Tower transmitters are low-powered since operating ranges are short. The usual equipment line-up is the TDD for intermediate frequency, TCA's and TCS's for medium high frequencies, and TDQ's or BC-640's for v-h-f.

The tower is required to receive on, and to guard, a number of frequencies. Receiver frequencies match transmitter frequencies except in the m-f and h-f bands. Receiver outputs are extended to loud speakers in the operating console. Where practicable, voice operated relays are installed to mute loudspeakers when no signals are being received. These relays flash a light on the console to indicate the receiving channel. All incoming and outgoing transmissions are fed into either a PE or VRF-1 voice recorder. The radio facilities in seadrome towers are basically the same as in the landplane tower except that fewer frequencies are required. Control towers are also equipped to communicate with crash units, ambulances, crash boats, crash trucks and derricks.

The heart of the radio communications system at air stations is the operations radio room. Operations radio rooms may be used by air groups or wings. The teletype center is usually located in this room, in addition to radio transmitter and receiver controls with plugboard connections as required. Separation of transmitters and receivers reduces interference problems. All transmitters, except emergency equipment, are housed in a single and separate building, with plugboard provisions for switching among units. The standard Navy transmitter line-up covers a power range from 10 watts to 3 kw and a frequency range from 200 kc to 156 mc. Monitor receivers and frequency meters are provided. An emergency engine-generator unit is furnished to insure operation in the event of a power failure. Test instruments and tools are provided for operating personnel to make routine adjustments and repairs. Major repairs and overhauls are made at Mare Island. Some air stations require additional miscellaneous electronic equipment. Low frequency radio localizers, generating on-course signals, guide aircraft to the field. Z-markers are located adjacent to the localizer and provide a steadily-modulated 75 Mc signal in the "cone of silence." At strategic points on the localizer courses, fan markers are located to act as fixed land marks. Ground Controlled Approach equipment is installed at Moffett Field and Oakland. On occasions Mare Island is called upon to assist on navigational-aid projects at Arcata, California. YG beacons and racons are installed for regular service and as training devices for flight personnel. Low-frequency and medium-high-frequency direction finders locate aircraft and follow aircraft in flight.

The Aerology Department's electronics equipments include ceilometers to measure cloud heights, wind velocity indicators, radiosondes, weather map facsimile, and weather-information teletypewriters. The shipyard Electronics Officer in cooperation with the station Communications Officers, provides installation and maintenance service as necessary. Requests for such service are given a high priority. Shipyard personnel are available on call to meet emergencies at all times.

Underwater Sonar Test Laboratory Conversion of USS Baya (SS-318)

By Lt. T. F. Dixon, USN

■ Streamlined high-speed ship design and development has generated a new family of sonar problems. A body moving slowly through water creates little cavitation and other types of noise. As the speed increases, noise levels rise to a point where the ship's own noise and water cavitation prevent normal sound detection and echo ranging operations. The Navy Electronics Laboratory, together with the Marine Physics Laboratory, are engaged in research to determine the nature and source of these sounds. The *USS Baya* (SS-318) was designated as a laboratory ship to serve as a tool in this work, as well as a vehicle for Mare Island Naval Shipyard work on suppression of machinery noises within submarine hulls.

Information "that various sonar equipments of the latest types would be installed" on the *Baya* led the Design Section to have visions of a sparsely-quilled porcupine submarine steaming down the bay. Since this ship was intended to serve as an underwater sonar test laboratory for use by the Navy Electronics Laboratory at San Diego, such suspicions were not without a basis. Actually the job proved to be much more practical.

Numerous conferences held with N.E.L. personnel resulted in a final line-up of sonar equipment as follows:

8 Topside mounts, consisting of:
1—JT Hydrophone mount, forward
2—Calibration mounts, forward
1—QLA mount, forward
1—WFA-1 mount, forward (used at present to mount QHB-1 Transducer)
1—JT Hydrophone mount, aft
1—WFA-1 mount, aft
1—Calibration mount, aft

Bottom-side seachests and projector mounts:
1—WCA Equipment with QB and QC/JK projectors ranging
1—NM Seachest sounding
1—Calibration mount, forward (6" diameter), which is retractable and may be trained
1—Seachest, forward, to accomplish installation of calibrated transducer similar to type CBM-78243
3—Thermocouple Projectors, 1 forward, 1 center and 1 aft (modified pit log valve. assembly) for calibration readings
1—Thermocouple guide tube in bow buoyancy tank

Installation of equipment inside the hull provides for maximum flexibility permitting various combinations for tests and evaluations. Return to port to effect re-rigging of transducers or equipments is not necessary.

WCA seachests and hoisting equipments have been modified. Cofferdam construction enables test personnel to change bottomside projectors without delay or costly drydocking.

The starboard hoist train mechanism, in addition to carrying the QB transducer of the WCA, may be used for the bottomside QLA-1 transducer. An improved system of hydraulic training has been provided for QLA-1 sonar. A dog clutch permits a shift from electric training for WCA operation, to hydraulic training for QLA-1 operation.

The QLA-1 installation includes equipment for operating from either a topside or a bottomside transducer with provisions for quickly switching from one to the other to obtain comparative evaluation data. The *Baya* was the first ship to receive the improved QLA-1 training system featuring a sector scan switch with the P.P.I. The scan switch allows the operator to adjust quickly the relative bearing and width of the sector he desires to scan, with provisions for automatically centering the sector on the bearing at which continuous training was stopped.

Extra cables and wires have been run from the forward torpedo room, via the control room, to the after torpedo room. Special terminal boxes have been constructed so that any combination of test circuits can readily be connected and readings taken in any compartment.

Separate power leads for electronic equipment have been provided. Two 15-kva 230-117 v. a.c., 60-cycle single-phase motor geenrators have been installed in the magazine stowage between frames 60½ and 64, port side. These are operated with cruiser-type 300-watt frequency stabilizers. Every effort has been made to maintain a constant and well-regulated source of power to reduce errors attributable to fluctuations in the primary power supply.

Separate inter-communication systems have been installed for laboratory technical personnel to eliminate interference with ship's personnel in the operation of the submarine.

Torpedos and storage spaces have been removed from the forward and after torpedo rooms. All tubes have been secured, except one, which has been retained for use in unforeseen problems or tests. This space has been utilized for test and work benches, as may be required by N.E.L. personnel.

Wireways have been designed and constructed under the superstructure to lay temporary cables and leads from top-mounted transducers to either the forward or after torpedo loading hatch, where provisions have been made to run cables through proper size tubes to equipment below. The standard Navy type torpedo loading hatch has been removed. A specially-designed cover in replacement has one hundred stuffing tubes of various sizes. Blank plugs can readily be removed or inserted as cable requirements may vary.

One of the first projects to be undertaken in the laboratory set-up is a comparison of the relative performances of QLA-1 and QHB-1 sonar equipments. The QLA-1 and QHB-1 transducers are mounted approximately at frame 22, port and starboard, respectively. Their P.P.I.'s are mounted side by side in the forward torpedo room.

By selecting suitable targets and studying their presentation on both the QLA-1 and QHB-1 scopes simultaneously, relative performance of each can be determined. Other measurements can be similarly provided for.

POLYSTRENE WINDOW OF SV-SERIES RADAR

Several vessels equipped with Navy Model SV-series radar equipments have experienced loss of power output from the equipments after they have been serviced. The trouble was finally located at the waveguide window in the base of the mast. It was determined that the polystyrene window and choke had been left off during installation of the equipment, thus causing a mismatch in the transmission line. Accordingly, all naval installation and repair activities are requested to take particular care during installation or repair of model SV-series equipments, to insure that the polystyrene waveguide window and choke are installed in the base of the mast.

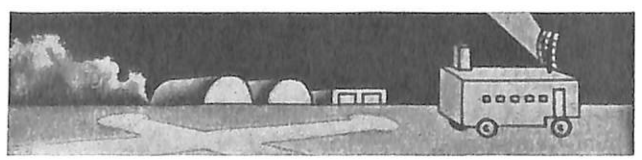
PO RADAR (AEW)—MAINTENANCE INFORMATION

The following information concerning tube difficulty experienced with the PO Radar has been reported by the *U.S.S. Philipine Sea* (CV47):

"Metal 6SA7 arcing to ground. It was noted that the circuits are designed for glass tubes and not metal. This is due to the fact that Pin 1 of glass 6SA7 is suppressor grid and pin 1 of a metal 6SA7 is the shield (metal can). In the circuit pin 1 is hooked back to the cathode which is usually then hooked to a tap on a voltage divider from B+. This puts the metal shield at a positive potential, with arcing to ground when tube clamp is tightened and consequently shorts the cathode."

The Bureau cautions electronic maintenance personnel when replacing tubes in this equipment to make sure that the same type tube (glass or metal) is used as that which was supplied with the equipment.

Type of Approach	Last Month	To Date
Practice Landings	8,332	116,059
Landings Under Instrument Conditions	374	5,577



Ground-Controlled Approach at Mare Island

By C. A. Baker

■ Since the close of World War II, many interesting electronic projects of special nature have been undertaken at the Mare Island Naval Shipyard. Among these is Project 257/47; "Overhaul and Reconditioning of AN/MPN-1A, Ground Controlled Approach Equipment." The strategic location of the Shipyard and its practically unlimited manufacturing resources made it an ideal West Coast Base for the repair and modernization of this aeronautical navigational aid. G.C.A. had not only proved itself during the final stages of the war, but had exceeded all anticipations for accuracy, dependability and practicability. It could only follow that this system would continue to be the Navy's accepted manner of guiding aircraft to safe landings during conditions of limited visibility.

The initial problems confronting the Navy Department in promulgating a G.C.A. operational and maintenance program were of such magnitude as to provoke considerable concern. First, a limited number of equipments was avilable and the wartime success of the system had created a demand for G.C.A. installations at all major air stations. How to distribute forty-eight equipments for operational and training purposes and meet all requirements for a nation-wide and advanced base air navigational program challenged the resourcefulness and ability of the chiefs of all concerned sections. Secondly, the problem of maintenance, involving almost every department of the Navy's repair facilities, was nearly as great as that of strategic assignment of equipment. A very limited number of equipment and stock spares had originally been procured. A considerable amount had been consumed during wartime service. Contracts had been completed and in most instances it would be impractical and uneconomical for private manufacturers to re-tool and re-organize for additional spares. The responsibility, therefore, rested upon the repair facilities of the Navy not only to recondition a considerable number of available equipments, but to install efficient and complete systems to continually maintain and improve apparatus involved.

A G.C.A. installation consists of almost everything electronic and mechanical in nature, most of these being of special design. Coordination of all work was paramount in establishing a maintenance program to accommodate both emergency and routine conditions. Aside from the complex electronic features of radar and radio communications, there are involved air conditioning, diesel engines, hydraulic systems, power distribution systems, heating and many other factors. Since the installations are mobile, trucks and vans together with accessories and ground tackle had to be accommodated in the

Figure 1—*South end of G. C. A. maintenance shop.*

FIGURE 2—*North end of G.C.A. maintenance shop.*

establishment of a repair program. An unobstructed area of ample size, preferably adjacent to the major repair facilities had to be provided for parking and spot shifting of the vehicles. Dry, well-ventilated storage spaces are required for the safekeeping and preservation of spare parts and accessories during the overhaul period. Among those familiar with G.C.A. equipment, it is readily agreed that there is an extremely large amount of electrical, electronic and mechanical devices to be found in so limited an amount of space. The precision and accuracy built into these systems, however, together with the overall compactness and completeness are a delight to the electronic and mechanical artisans. Yet, each feature and each item presents an individual problem with respect to manufacture and repair. Not only must the shipyard meet the immediate overhaul requirements of the maintenance base, but must be prepared to meet the urgent needs of the operating equipments in the field.

Just over a year ago when Mare Island was designated as the West Coast G.C.A. Maintenance Base, the Shipyard Commander, the Electronics Officer, the civilian head of the Electronics Office and all Industrial Shops immediately recognized the importance, as well as the problems involved, in setting up adequate facilities and accommodations for this new and highly complex project. A clean, well lighted shop of sufficient floor space to accommodate handling and reconditioning of all electronic components was required. Storage space for spare parts, antenna reflectors, accessories and supplementary

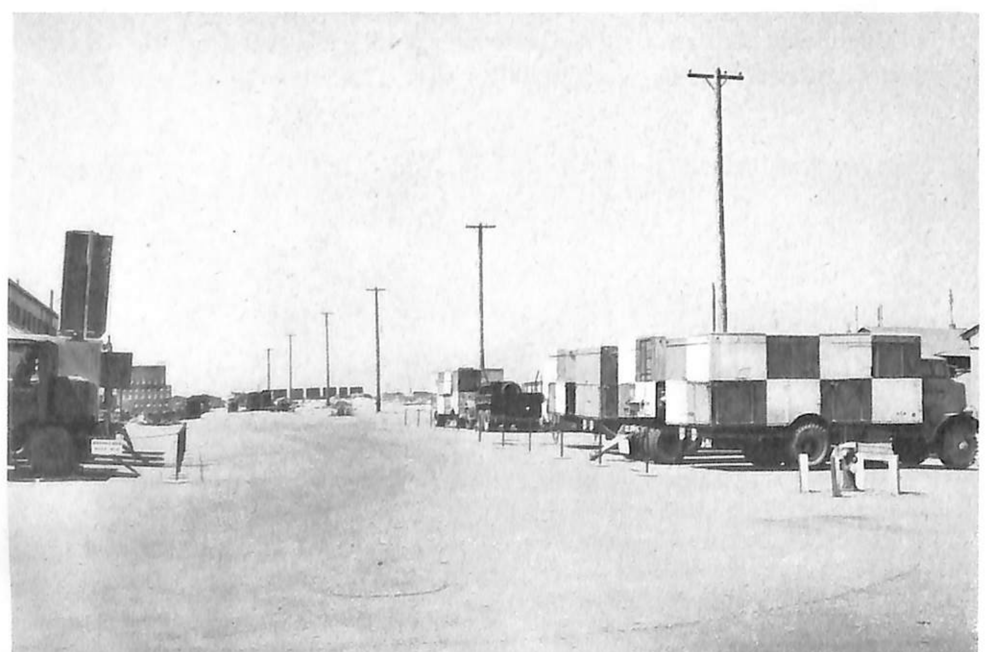


FIGURE 3—*Parking area adjacent to G. C. A. maintenance shop.*

equipment was a necessity. An open, hard surfaced parking area of sufficient size to accommodate all vehicles and permit easy shuttling was desired and in addition all accommodations were to be centrally located, adjacent to a satisfactory testing ground where all work could be concentrated without need for undue shifting of the vehicles and loss of working time in tansit. Initially, five AN/MPN-1A equipments were on hand for overhaul. Fifteen vehicles, together with all equipment and accessories, had to be accommodated in such a manner that equipment not undergoing immediate overhaul would be preserved and suffer no deleterious effects from idleness in storage. Most of this equipment had been received from overseas, where the general casualties of normal operation and shipment had accrued, together with severe damage and deterioration due to weather and climate. Many of the original spares had previously been utilized or gone astray overseas. The immediate problem confronting the shipyard was to set up without delay and commence work, in order that these equipments on hand could be overhauled, tested, and returned to the field to meet insistent demands for air navigational safety and preservation of life.

Building 581, located near the Mare Island causeway offered the best location for the requirements involved. Shop floor space was adequate, storage rooms were immediately adjacent, and the entrance bordered on an ideal parking and vehicle storage area that in addition provide a suitable radar "view" for tests, calibrations and proof runs. This location, while close to all required repair facilities, was out of the line of congested traffic. Work could be initiated with minimum interference to other industrial operations. Figures 1 and 2 show the main repair shop where electronic components are reconditioned and bench tested. Figure 3 shows the parking and assembly area adjacent to the shop. The reconditioning of the precision antennas must of necessity be accomplished in a clean, dust free location where all required tools and materials are immediately available. Figure 4 shows the excellent, well lighted section devoted to this particular procedure. Figure 5 depicts a portion of the work required on certain installations and the reconditioning measures taken. The Equipment Trailer is shown completely stripped of equipment, controls and wiring. Thorough cleaning and removal of rust and corrosion has been accomplished, after which the enclosure has been spray painted. Figure 5 shows the equipment racks outfitted with all new cabling, wiring, plugs and connector boards. On

FIGURE 4—*Machine shop, showing maintenance section for G. C. A. precision antennas.*

the table in the foreground is seen a new multi-conductor cable under assembly.

Operations such as these are tedious, require a great amount of care in layout and fabrication, and must be absolutely accurate throughout. All wiring is lock-stitched together to form a compact cable, after which a wrapping of linen tape is applied and sealed with glyptal. Terminal boards and plugs are then attached with new designation strips and cable markers affixed. Obsolete equipment and "jury rig" modifications made in the field are brought up to date; subsequent to repair and overhaul, each component unit is tested individually prior to the approval tests of the entire equipment. Co-ordination of shops concerned with related work is maintained so that all completions will dove tail and the reassembly, reinstallation and test periods proceed without delay. Upon satisfactory completion of all shipyard tests, the overhauled equipment is taken to the Naval Air Station, Oakland, where actual flight checks are accomplished before definite approval for re-issue is made.

The operation and overall functioning of G.C.A. systems is one of the most interesting and fascinating in the field of present day electronics. The overhaul and readjustment of the equipment proper likewise is of unusual interest and presents to the maintenance personnel a widely diversified series of problems and manipulations. Since the inception of the program, it is felt that marked improvements have been made, both in the field and at the maintenance bases. Certain repair and replacement items still remain on the critical and hard to procure list; the continued enthusiasm, efforts and ingenuity displayed by operational and maintenance personnel, however, are daily decreasing the difficulties. Maintenance Bases are conducting a persistent drive to fabricate and procure emergency supplies for the field. At the same time the inoperative equipments under overhaul must be rushed to completion for reissue to important stations. AN/MPN-1A equipments and the G.C.A. units are daily performing more extensive and accurate service and have established themselves as the guardian to safe landing of aircraft under seemingly impossible conditions of weather and atmosphere. The Mare Island Naval Shipyard extends to all G.C.A. field personnel its thanks and appreciation for the care and preventative maintenance service provided for the equipment in their charge. Our problems are mutual and the maintenance bases are your service agency, ready to provide you with all available technical assistance and material in time of emergency.

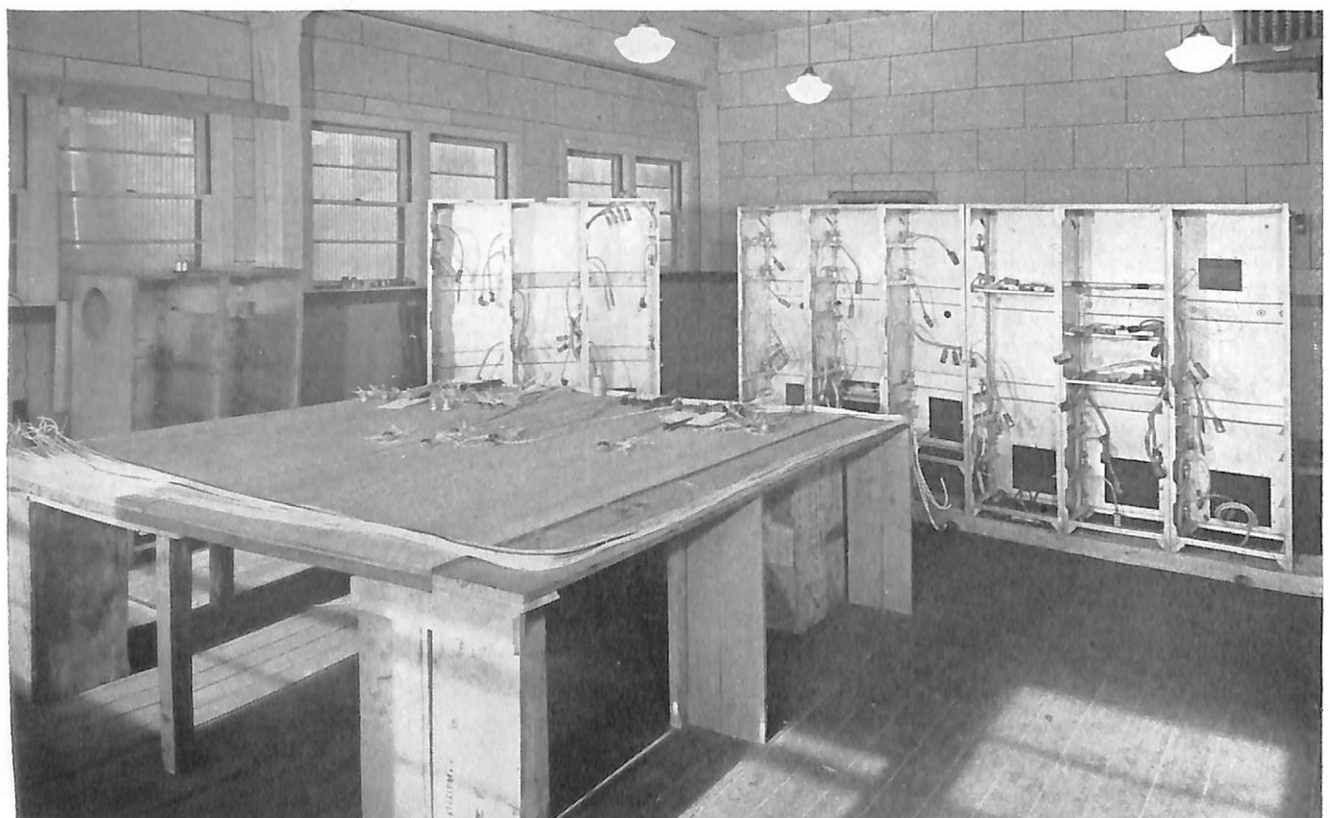


Figure 5—*G. C. A. equipment racks being refitted with wiring, plugs and connector boards.*

Internal Security Radio Twelfth Naval District

By Joy H. Hansen

■ The Internal Security and Industrial Control Unit of Mare Island's electronics organization consists of one electronics engineer in the Electronics Office and seven technicians from Shop 67.

The Engineer is responsible for the technical supervision of the Internal Security and Industrial Control System. He makes final tests and inspection of all installations to insure compliance with communication regulations.

A leadingman radio mechanic directs all the activities of the serviceman.

Two radio mechanics are continually on the road doing routine maintenance work and emergency repairs on the equipments of these networks, two are in the shop performing major repairs and alterations to the equipments, and two are assigned to the installation work.

The majority of the radio equipment in the Twelfth Naval District is frequency- or phase-shift modulated. At each of the thirty fixed stations is a 50-watt Galvin Motorola FSTR transmitter and receiver, usually remotely-controlled from several points with the PA-8270Y remote control unit. Three hundred mobile stations are equipped with either a 25-watt Galvin Motorola FMTR transmitter and receiver, or a 25-watt Galvin SCR-608 transmitter and receiver. These installations are supplemented by 2-watt Galvin SCR-610 transceivers and Link MN-5 transceivers at portable or semi-fixed stations.

Four classes of service are rendered by this unit, as follows:

1—Internal Security circuit, on a frequency of 38.3 Mcs, is primarily for the use of marine guards, civilian police guards, the fire department, and the medical department.

2—Industrial Control circuit, on a frequency of 32.86 Mcs, for the use of industrial activities such as locomotive control and transportation pools.

3—The Decommissioned Ships' circuit, on a frequency of 30.3 Mcs, also uses the Internal Security network of 38.3 Mcs to effect liasion between the security activities on the two networks. This circuit also serves the Pacific Reserve Fleet in the district. This network is the only means of communication between the separate groups of ships or nests, and the control stations located on shore.

4—The Shore Patrol Service employs only crystal-controlled single-frequency receivers tuned to frequencies between 150 kc and 2500 kc. Although not an integral part of the internal security networks, is is an associated system for liaison with local police forces.

Field and maintenance work is divided between two geographical areas: the Bay Area and the Inland Area. There are approximately 300 units in each area. In case of emergency no definite line is drawn. The serviceman nearest to the trouble receives instructions by radio.

Service trucks and field engineer's vehicles have mobile radio installations to maintain contact with stations under repair and headquarters at Mare Island. Each service truck is equipped with 1 mobile radio installed, 2 spare mobile FMTR chassis, 1 spare SCR-608 chassis, 1 spare PA-8270Y remote control unit, 2 complete sets of crystals, tubes, vibrators and fuses for all types of equipments serviced, and meters, test equipment and tools necessary for all maintenance, testing and repair.

The field maintenance schedule provides for at least one weekly visit to each installation. For stations where more than two hours' travel time each way from Mare Island are necessary, arrangements have been made to maintain equipment locally, as in the case of N.S.D. Clearfield, Utah, and N.A.D. Hawthorne, Nevada. These stations have spare parts and equipment with necessary technical information. Some stations have established local repair shops and can effect their own repairs but generally it is more economical to service equipment with Mare Island personnel. Mobile installations are made at Mare Island when practicable. Complicated or technical service work in the field is kept at a minimum by substituting spare units carried in the service truck and returning the faulty unit to Mare Island for repair. After repairs have been made, original equipments are returned to original locations.

Standby units installed at the main stations are equipped with an automatic change-over switch controlled from a point where a 24-hour watch is kept. Many off-duty calls are eliminated by this device. At nearly all main stations automatic-starting ER-2 Kohler emergency power units furnish power in the event of commercial power failure.

Most of the main stations in the Twelfth Naval District are equipped with handsets so that, in case of emergency or disaster, the control of the network may be shifted to the transmitter itself. Formerly two remote units were required for the use of two circuits from one point. The installation of a monitor one one line and a remote unit on the other permits switching either way. The remote control serves a double purpose and permits continuous monitoring.

The decommissioned-ship nests have an SCR-610 installed as a primary transmitter and a battery-operated SCR-609 at the control barge as a spare.

The tug-dispatch-circuit control stations, on a frequency of 2830 kc, equipped with amplitude-modulated transmitters and receivers are also maintained by the Mare Island organization.

SOFAR in the Twelfth Naval District

By F. E. Dunklee

■ Mare Island participation in the "sofar" (SOund Fixing And Ranging) project, was assigned by the Bureau of Ships in June 1946. Mare Island's principal concern with the sofar project has been logistic. In essence the job seemed simple enough. There was a cable laying ship to be obtained and fitted out; hydrophones to be planted in the sea a few miles off shore; submarine cables to be laid to connect the hydrophones with suitable amplifying and recording equipment to be installed on the beach. That was all!

The Army had done similar work in shallow water. The Navy had some experience with magnetic loop cables and sono-radio buoys, also in shallow water. A tentative completion date of 30 June 1947 was set with every expectation of meeting it.

The choice of hydrophone sites was governed by two fundamental considerations: 1—they should be planted at a depth of 400 to 500 fathoms in order to reach the "Sound Channel," and 2—the submarine cables should be as short as possible to reduce attenuation losses.

Hydrographic charts studies led to the conclusion that the best locations available along the U. S. Pacific Coast were at Monterey and Point Arena in California. Preliminary bathymetric and bathygraphic surveys were made in those areas by the *USS Fieberling* during the summer of 1946. To fix the *Fieberling's* position with the required precision while making these surveys, four "shoran" stations were set up ashore, two near Monterey and two near Point Arena. The equipment on shore was the AN/CPN-2 radar beacon, interrogated by an APN-3 installed in the survey ship. As only two CPN-2 equipments were available, they were installed in vans and moved from place to place as required.

By the time the bathymetric surveys were completed, the Army cable ship *William Glassford* arrived at Mare Island for overhaul and fitting out for the job of laying cables. After extensive overhaul, the *Glassford* left Mare Island on 4 March 1947 to plant hydrophones and lay the first cables at Monterey. The shore installaitons at both Monterey and Point Arena had been completed. Only the hydrophones and connecting cables were required to put the station into commission. Fortunately, it was decided to spend some time on dummy runs to learn the technique of laying, splicing, and picking up deep sea cable. The cable is paid out over the bow with the ship steaming at from 1 to 3 knots. The angle at which the cable tends away from the ship is from 10 to 60 degrees. The inclined plane which the cable forms between the ship and the bottom may be several miles in length. Three hydrophones were planted in the Monterey Submarine Canyon, at 350 fathoms depth, connected by 14 miles of 115P submarine cable to equipment on shore. Another hydrophone connected to 7 miles of demolition and 6 miles of 109P submarine cable was planted at 400 fathoms. To land the cable through the surf, the cable ship lay-to several hundred yards off shore beyond the breakers. "Ducks," loaned to the sofar group by W.O.B.S. (Wave Observation Bureau of Ships) project conducted by the University of California, were most helpful in landing messenger lines and cables on the beach. These amphibian vehicles are ideal for work of this kind. They had no difficulty in pulling the cable ashore, over loose sand, where any other type of vehicle would have quickly bogged down.

The Monterey sofar station was in commission by mid-march 1947. Although "shots" were received and recorded from Hawaii, it soon became apparent that successful operation with selected hydrophone locations was impossible. Echos and reverberations from the sheer canyon walls so obscured the reception pattern that accurate timing of the "shot" could not be obtained. Another site for the Monterey station was selected at Point Sur, about 20 miles south of Monterey. Relocation of the hydrophones and shore equipment at the new location will be completed this summer.

Original plans for Monterey called for installation of seven hydrophones. A fire in the engine room of the *Glassford* upset these plans. Little work was done on the sofar project in the Twelfth Naval District during the remainder of 1947. The *Glassford*, renamed *USS Nashawena* on transfer to the Navy, was reconditioned for further sofar work. Although far from being a seaworthy vessel, this ship has one highly desirable quality required in cable laying ship—she has triple screws and maneuverability required for precise cable and hydrophone laying.

Work is now proceeding on the relocation of hydrophones at Point Sur and installation of cables and hydrophones at Point Arena. The technical and material problems of the sofar installation approach solution. Barring further accidents, the California installations should be completed this summer.

"HOME YARD" COPIES OF NAVSHIPS 4110

The naval shipyard originally scheduled to accomplish an overhaul on a naval vessel often does not do so because of changes in the schedule. This results in a large volume of correspondence, because the originally-scheduled yard must mail the "home yard" copy of the vessel's "Ship Electronic Equipment Inventory Form" (NavShips 4110) to the yard that is actually to accomplish the overhaul. Delays in transit, etc., have resulted in no on-hand inventory at the overhaul yard, when needed.

In order to improve this situation, the home yard copy of the inventory form will, in the future, be mailed to the appropriate ship type commander, who will forward it, when necessary, to the proper overhauling naval shipyard. This procedure will be incorporated in the next change to "Instructions for Maintaining Ship Electronic Equipment Inventory System", NavShips 900,135.

ANTENNA DRAINAGE HOLE

It has been reported that moisture has accumulated in the type -66046 and -66047 antennas, in some instances to the extent of causing damage to the antenna when freezing occurs.

In order to overcome this difficulty, a 1/8-inch hole should be drilled in the base of each antenna. This hole should penetrate the adapter base and the lowest mast section as shown in figure 1. This improvement is within the scope of the ships force and should be accomplished at the first opportunity.

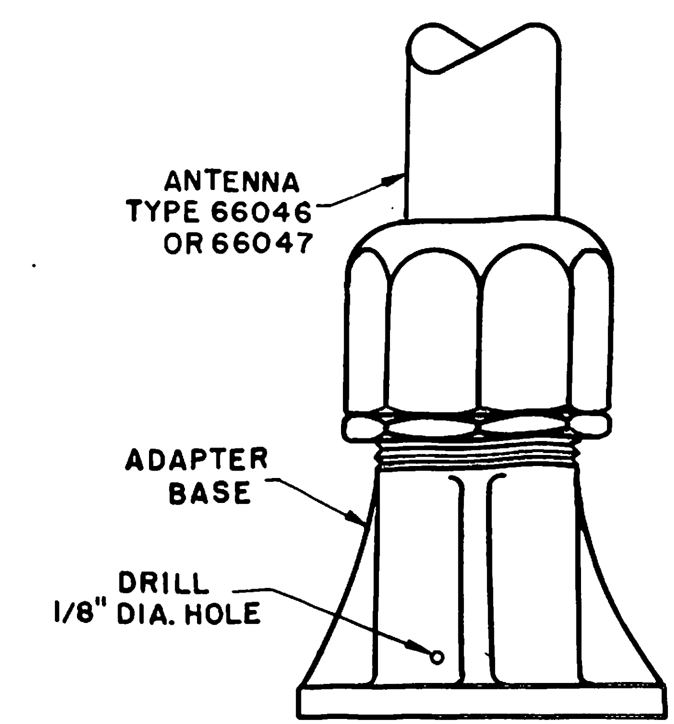


Figure 1—*Prevention of moisture accumulation by drilling a small hole, as shown, in the antenna base.*

Electronics Exhibit at the Mare Island Naval Shipyard

By Ed Case

■ The Mare Island Electronics Exhibit was originally conceived and established as a part of the Shipyard's Electronics Familiarization Program and for the Navy Day observance on 27 October, 1947. The exhibit attracted so much attention that it is maintained in a ready status at all times for Naval personnel, civic, scientific, educational, and other interested groups. Electronic counters officially recorded 20,880 persons who attended the Electronics Exhibit on Navy Day, 1947, and another 20,000 have since attended it in groups and as individuals. The public's interest in Navy electronics is amply demonstrated.

The theme of the exhibit is "The Future of Electronics," exemplified by a working model of a simplified atom suspended from the ceiling opposite the entrance gate and at the far end of the corridor. This "futuristic" display contrasts with the more prosaic exhibits on either side and nearer the entrance to the building.

The exhibit occupies two floors of Building 208. Only a brief description of the outstanding exhibits can be offered here.

The transmitter display illustrates Navy type transmitters. Featured is a TBL-10 transmitter operating into an artificial load of multi-colored fluorescent lights. Another TBL, with the interior exposed to the visitors, demonstrates Navy type of construction.

A radio-controlled automobile operated by remote control occupies a prominent place in the exhibit. Push buttons control the transmitter on 73.9 megacycles using tones of 300, 600, 955, 1390 and 3000 cycles to turn right, turn left, control forward motion, control backward motion and blow the horn. A portable remote control box with a portable cord attached is available for visitors to operate.

The Radio Frequency Exhibit is an assortment of gas-filled tubes caused to fluoresce by radio frequency energy flowing from an open-ended wave guide.

A small part of the crowd of over 20,000 persons to visit the Electronics Exhibit over Navy Day, 1947.

Radio-controlled automobile—the most popular exhibit—effectively demonstrates remote control by radio.

The Radar Exhibit includes SG, SU and SC-2 radar equipments and VG, VD-2, VC-1 and VF radar repeaters together with the various and respective components. Much of the equipment is in operation, displaying various patterns and traces. Other units are broken down to show the intricate connections and parts.

An animated background of attractive and artistic murals illustrates the principles of echo ranging, listening, sounding, air and sea rescue, sofar, depth-charge direction indicator and sonar-buoy detection. QC and NM transducer section are on display. Recorded underwater sounds are reproduced for the benefit of visitors.

The Shore Electronics Stations Exhibit is quite complete. It includes many types of communication equipment utilized in the "Internal Security" network. A-m and f-m receivers with panoramic adapters and switching arrangements permit both visual and aural comparison.

An air station control tower replica includes operator's console; 17 medium, high- and very-high-frequency communication receivers and associate equipments; wind direction and velocity indicator, voice recorder and ceilometer recorder. A miniature rhombic antenna complete in all details, and

General teletype exhibit features Model 15 teletype and perforators arranged for visitor's participation.

2,376 messages were handled through this amateur radio station during Navy Day, 1947

Animated mural depicts detection of submarine by sonar.

a scale model of the Dixon, California, Navy Communication Station feature the shore radio display.

Radio telephoto equipment with samples of news pictures is included.

The Teletype Exhibit consists of a large assortment of various teletype equipment, including tape and page printers, projector screen units, perforators, reperforators, keyers, Morse printer, test sets, etc. The display is so arranged that most equipment is in continuous operation and certain units are arranged for visitor participation. An intriguing exhibit is the Morse printer which automatically

Radio frequency exhibit. Energy from the open end of the model SV radar transmitter lighted argon lamps on display racks.

Dramatic operation of depth charge direction indicator is demonstrated by animated mural and indicating devices installed in replica of submarine section.

transcribes ordinary dot and dash characters to plain English.

The INFRA Exhibit shows the use of the C-3a infra-red receivers employed during the last war. A darkened light-tight booth with several INFRA receivers demonstrates the performance of the equipment under conditions of darkness without the aid of visible light.

"Mystery Exhibits" for the entertainment of visitors demonstrating scientific principles, created much interest and amusement. Electronic bells without clappers are rung by magnetic distortion through the action of a microphone and amplifier. A "jumping ring," demonstrating the principle of repulsion action in an alternating primary coil, as opposed to a one-turn secondary (which is the "ring") is made to jump over the top of one column and down the other column when addressed sharply over a microphone. Visitors are encouraged to write their names with a stylus which controls the electron beam of an oscilloscope. The writing appears on the face of the oscilloscope tube and follows the movements of the stylus manipulated by the vistor.

There are many other items, designed to intrigue the uninitiated in electronics, and pique the curiosity of old-timers and those who think they know all the answers. Even after 40,000 visitors have seen it, the exhibit still retains its freshness and value as a popular symposium of modern electronics.

General radio display including model SC-2 indicator, remote plan-position indicators, radar plumbing and the mysterious "jumping ring."

General Line School Monterey, California

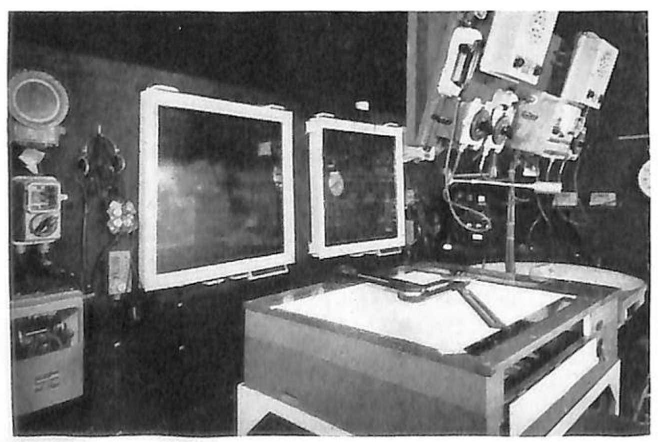
By Lt. Comdr. R. D. Lagle, USN

■ The General Line School at Monterey, California has the job of providing the officer who is not a Naval Academy graduate with instruction on the many items peculiar to his profession which his civilian education did not cover. The electronic phases of this educational program cover C.I.C., Loran, A.S.W. and others.

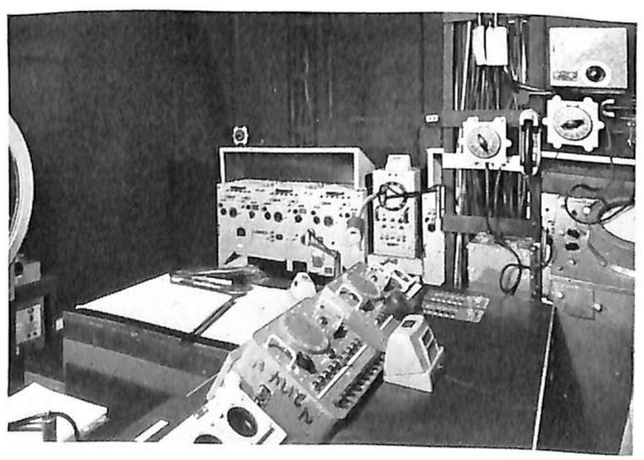
The electronics installations at present consist of a C.I.C. installation, an Anti-Submarine Warfare installation, and a loran installation for navigational instruction.

The C.I.C. installation approximates two shipboard C.I.C.'s, one for an *Essex* class carrier and one for a *Sumner* class destroyer. The C.I.C. installation includes a problem generating room, a helm station associated with each C.I.C., a transmitter room and a workshop. The facility with which it was possible to reproduce actual C.I.C. arrangements and equipment was governed by equipment available as well as the shape and size of the spaces provided. The "crash" basis on which the installation was made did not permit inclusion of many desirable refinements. This however, is not a handicap to the intended utility of the C.I.C.'s. The school does not attempt to turn out fully qualified C.I.C. teams but rather to acquaint general line officers of limited sea experience, with the functions and capabilities of C.I.C. In general, the purpose of the school will be met if at some time in the future a graduate walks into an actual shipboard C.I.C. and has a definite feeling that he is on familiar ground.

Complete SG radars without antennas are installed. No trainer for use with the SG, such as the OBJ, was provided so the SG actually does not enter into the solution of any of the problems and exercises. However, it was felt that the mere presence of an operating SG was essential to the successful creation of the atmosphere of reality which was being striven for. An SG indicator is installed in each C.I.C. and its associated main frame is located in the transmitter room. Control amplifiers, amplidynes, load dividers, etc., are provided in the transmitter room so that if it should ever be desired to install antennas and put the equipment into operation, this could be done quickly and easily. Since the SG radar can not be used for obtaining target bearing or for navigational checks during the problem, a talker stationed at the double D.R.T. in the problem generating room functions as the SG radar operator. Using a universal drafting machine, he is able to supply the surface plotters in C.I.C. with range and bearing of surface targets.



DD C.I.C. showing observer's platform, D.R.A., status boards, fiddle boards, D. R. T., and radio receivers.



Problem generating room showing instructor's desk, radar repeater, distance and revolution transmitter, and selector switches.

An SR console is located in each C.I.C. No SR main frame is provided. Instead, the SR is used with the OCZ radar trainer. The OCZ is primarily an operator training device but it fits very nicely in this installation. It provides three controllable targets which appear on the SR scopes in realistic fashion. The three targets available permit the use of fairly complex fighter direction problems and this will be enhanced by the later installation of an OCJ radar trainer providing six targets with preset courses and speeds.

The destroyer C.I.C., in addition to the radar indicators, has a VC-1 radar repeater and a VF radar repeater. Since VJ's were not available, modified VC-1's with 12-inch scope tubes have been installed. The carrier C.I.C. is provided with four VC-1's, one VF, and a VG-1. A type VE radar repeater is installed in each helm station and a third in the problem generating room for use in tuning up the OCZ's. The instructor is provided with a 12-inch VC-1 at this desk in the problem generating room.

Communications are available over sound-powered telephones, 1MC, 21MC, 24MC, the simulated TBS, and the simulated v.h.f. The sound-powered telephone system is fairly complete. It includes all circuits that would normally exist between C.I.C., the helm and such circuits as are useful between the C.I.C. and the problem generating room. Conventional shipboard equipment was used throughout the system. It might be pointed out that the CV and DD systems are separate, thus making it possible to run separate problems simultaneously. The 1MC speakers provided are not used for general announcing. Instead, a rack of reproducers (tape and wire recorders, and record players) is installed in the problem generating room. Battle noises, GQ alarms, and the like are sent out over the 1MC. A switching arrangement at the instructor's desk makes it possible for him to select the output of any reproducer or any combination of their outputs at any time. The 21MC and 24MC intercommunication system is conventional. Here again the DD and CV systems are separate although it is possible to talk to either C.I.C. and helm station from the problem generating room.

The TBS system consists of actual TBS handsets and control units. A "black box," called the TBS simulator, contains the necessary circuits to make possible a realistic simulation of actual TBS operation. The output of the TBS handsets is fed into an amplifier and thence to the various TBS speakers.

Instead of the usual RPU's, the input to the simulated v-h-f system is by means of sound powered telephone hand and chest sets. Four channels are provided, each connecting to a phonograph pre-amplifier which was chosen because it satisfied the input impedance and gain requirements and could be readily manufactured from drawings on hand. The output of these pre-amplifiers is fed through a patch panel to regular shipboard speaker amplifiers. By means of the patch panel, located at the instructor's desk, various channels can cross connected, if desired.

CV C.I.C. showing air and surface fiddle boards, D.R.T., radar repeaters, horizontal and vertical air plots.

The dead reckoning system consists of two parts, one controlled by the student at the helm station, and the other controlled by the instructor. A C.I.C. attack teacher control unit is installed in each helm station. This unit provides course and distance information for the D.R.A. in C.I.C. and its associated D.R.T. In the problem generating room a C.I.C. attack teacher is provided for each C.I.C. It is also known as a double D.R.T. The top table of the double D.R.T. is connected in parallel with the D.R.T. in C.I.C. and consequently is controlled by the student operating the attack teacher control unit in the helm station. The bottom table of he double D.R.T. is conrolled by the instructor; he has at his disposal a course transmitter and a distance and revolution transmitter, both of which are test instruments adapted to the needs of this installation. The instructor's desk is equipped with speed and course indicators controlled from the helm station. Each attack teacher control unit is also connected to a conventional pitometer log indicator in each C.I.C.

O.S.C. information is fed from each attack teacher control unit to an O.S.C. synchro amplifier in the helm station and is then distributed, through an O.S.C. distribution switchboard in C.I.C., to the various repeaters.

D-C power for the dead reckoning system is provided by a motor-generator set located in the transmitter room. This room has a large tube locker and adjacent to it is the workshop, which was provided for requisite maintenance on the electronic equipment.

The installation of a problem generating display system is under consideration upon the completion of development work by the Naval Electronics Laboratory, San Diego, and its eventual production.

The A.S.W. installation was performed by ship's force under the direction of a Bureau representative. It consists essentially of two QFA sonar attack teachers, together with dead reckoning equipment associated with them, and one QFL tactical range recorder teacher.

The loran installation for navigational instruction consists of a number of loran equipment models with either real or simulated r-f inputs. An antenna distribution system permits any equipment to be operated from either signal source.

A recently authorized addition to the electronics installation is an interim v-h-f equipment for operational communication between the school and the destroyer assigned to operations with the school.

Electronics in Harbor Defense

By R. H. Brown

The ability of electronics to provide accurate answers to tactical problems of modern warfare is being utilized to modernize the Nation's harbor defenses. Defining the military mission, evaluating the tactical problem, and designing the electronic system to provide the correct answer has constituted a challenge to the Navy.

In the past, Harbor Defense was essentially a problem of detection and identifying slow moving surface or subsurface craft. With the advent of guided missiles, underwater sneak craft, new quiet submarines, and A.S.W. hunter-killer groups with air support, a new concept of Harbor Defense came into being. The increased tempo of modern warfare demanded that equipments be made more accurate at greater ranges, that tactical organizations be made more flexible, and that a modern system be developed to make a better man and machine team.

The implementation of harbor defense systems and equipment development, directed by the Chief of Naval Operations led to the establishment of the U. S. Naval School, Harbor Defense, Fort Winfield Scott, San Francisco. The technical problem of system development and installation was assigned to the Mare Island Naval Shipyard. Buildings and facilities are provided by the Army. The past year of designing, planning, installation, and equipment evaluation is an outstanding example of the progressive action possible where the Army and the Navy cooperate to the fullest extent. This cooperation has enabled the Mare Island Naval Shipyard to design and manufacture a modern harbor defense system which incorporates the most advance thinking by both services.

In sharp contrast to the World War II harbor defenses, Mare Island Naval Shipyard has designed a system which is essentially a shore-based C.I.C. collecting electronic detection information from the air, the surface, and the subsurface. This C.I.C. is a tactical organization providing for information evaluation and coordinated action from one command point. The system has been designed so that distant sources of information can operate as individual control points or be linked together as a secondary system in cases of military damage.

The present harbor defense system can be considered in three sections as air search, surface search, and subsurface search. The most serious problems center about equipment designed for underwater detection. Many of the country's laboratories are working in this field. The U. S. Navy Electronics Laboratory, at San Diego, is cooperating with the Mare Island Naval Shipyard in equipment development and evaluation. The physics of the problem are such that nature makes no effort to help the scientist in his search for an answer and each detail becomes a personal challenge. Underwater equipment now in use includes echo-ranging heralds (harbor-entrance ranging, and listening deviecs), magnetic indicator loops, various types of audio listening hydrophones, and sono-buoy hydrophone floats. The limitations of these equipments leave much to be desired. Navy development groups can expect little outside help from commercial organizations who have little or no interest in underwater sound equipment.

With this feeling of responsibility, the Mare Island Naval Shipyard is pursuing a dual course in regard to underwater sound equipments. One is assistance in new development and evaluation; the other is a most practical approach to getting better results from present equipment by modifying installation techniques, the operation, or the equipment itself. Great strides have been made in advancing installation techniques with the cooperation of the Seacoast Service Test Section. The Army has provided several important items for installation evaluation, such as gasoline-driven cable reelers, cable jacks, special buoys, cable tanks, and the sea use of an Army Mine Planter. Operating experience gained by Army and Navy personnel has resulted in new installation techniques combining the best points of both services. These new ideas will be evaluated by the installation crews and will be the basis for final recommendations.

Modifications of present day underwater sound equipment and operating techniques are pointed to adapt the equipment to the overall harbor defense system. Much effort is being directed towards more consistent operation of the equipment to facilitate the use of information for electronic plotting. The electronic plot is made up of composite information from several sources and the final value of such a system is dependent upon the accuracy and dependability of each single source of information. Such a system imposes strict requirements as to the capabilities of each piece of equipment and provides a source of military characteristics for the design of new underwater detection devices. Research on these points is a function of the U. S. Navy Electronics Laboratory.

Surface detection equipment utilized by the harbor defense system is more conventional. The present shore based radars are augmented by mobile radar units which tremendously increase the flexibility of the radar system. Each unit consists of a truck with a power trailer which can be located some distance away from the operating point. Installed in each unit is the radar, IFF, radio, early warning receivers, and a special pre-evaluating system which allows radar information to be transmitted to the master C.I.C. by radio carrier. Tests are to be conducted to determine the feasibility of modifying the system to include transmission by radio carrier and landline. In the case of advance base operation, the mobile unit can be used as a part of the complete system or as an individual unit.

Present surface radars are limited by inability to provide adequate air coverage. This characteristic is being given careful study. The future holds promise of several equipments combining both air and surface search. Surface radars in harbor defense are assigned the normal operation of early warning search and the tracking of known surface targets. Some air coverage is provided, but dependence on air information will have to be placed on actual air search equipment.

The requirements of a harbor defense system for both surface and air search are based on the Harbor Entrance Control Post responsibility to provide facilities for the direction and control of hunter-killer operations. These hunter-killer operations combine aircraft and surface ships with demands for a complete and accurate air-surface plot at all times.

Air control is not fighter direction, since interception of enemy craft is an Army function, but it combines many similar intercept problems. The problem of patrol, detection, and identification of a strange target differs from actual fighter direction only in that the target is a surface craft. With these parallel requirements, the system is designed for hunter-killer operation, flexible enough to be used as a secondary fighter direction control.

This basic description establishes the harbor defense system as a master C.I.C. for air, surface, and subsurface information. To accomplish this objective practically every field of electronics is exploited. The underwater phase includes echo-ranging heralds, magnetic indicator loops, audio listening hydrophones, and several new devices under development. In the field of micro-waves are mobile and shore based radars, IFF, early warning receivers, local television, beacons, infra-red, and radar relay links to transmit radar information by radio carrier. The aircraft work adds high-powered communications, A.E.W. equipment, and specialized recognition. The C.I.C., or actually the Harbor Entrance Control Post, further utilizes teletype, local inter-communications, distant communications by both landline and radio carrier, disc and magnetic tape recording, and electronic plotting devices.

Mare Island Naval Shipyard has designed the harbor defense installation as a system incorporating all types of electronic information, not limited by the present quantity or quality of equipments. Any presently installed equipment can be replaced by more modern types without changing the system, the only effect being to increase the overall efficiency.

The problems of a normal shipboard C.I.C. differ in many respects from shore based problems. One outstanding advantage of shore based C.I.C. operation is fixed point for plotting with all target motion relative. A technical advantage is gained by relatively few limitations as to equipment size, weight, or location. The C.I.C. problems of information evaluation and proper action are complicated in harbor defense however, due to the varied amount and nature of the information. The manner of information presentation must be such that no doubt exists as to target identity. Its character must be established as friendly or unfriendly, air, surface, subsurface, military, commercial, or whatever the case may be.

It naturally follows that the action initiated by a Harbor Entrance Control Post may involve airborne units, surface craft, electronic challenging and identification, shore batteries controlled mine fields, or a combination of these active forces. The electronic problem is a many-sided one of search, detection, identification, communications, and coordinated action. The military value of such a system is not only the efficiency of any single control point, but rather the system's flexibility to allow duplication of control which can be assumed by a physically removed subordinate control point. These points indicate the complex nature of a modern harbor defense system as compared to general C.I.C. thinking.

The present answer to these problems of a combined C.I.C. may be found in the harbor defense system conceived by Mare Island. Essentially, the system combines information from the various equipments in a central control post. The actual information from any one equipment is pre-evaluated by the operator and electronically transmitted to a tactical plot which is a composite of information from all equipments. This tactical plot provides the staff control with complete information on every detectable target in the area. From this information, proper action can be taken by air or surface units.

The sea work connected with harbor defense is an electronic phase not too well known. Here the problems acquire new complications. Audio and super-sonic frequencies pose several transmission difficulties under normal conditions. In this case several miles of underwater cable runs are added. Cable movement or other distortions of the earth's field will induce noises. The normal noise of fish, shrimp, surf, etc., is included, and the mechanical noise of buoys, chains, etc., combine to present a provocative problem of obtaining low-loss transmission. The shore handling, ship loading, and actual laying of cable is a fine art of rigging, seamanship, and near-perfect navigation. The splicing of submarine cable under sea conditions requires an experienced splicing crew as well as good ship handling. The unforeseen difficulties of breaking or losing a cable require quick decisions regarding position plotting, buoying, and grappling operations. Cable testing and fault finding techniques are complicated by conditions arising from salt water leaks, cable damage, and weather conditions. As an example, under certain conditions the standing wave ratio test is best, while at other times the resistance bridge is the only method. If neither one of these tests work, what then? Generally speaking there are five or six possible methods of cable testing, but under certain conditions some methods either won't work or give confusing answers. Cable work requires specialized experience.

Balancing of landlines is a problem due to changing impedances of the sea load and the transmission factors are often influenced by induced loads and losses either ashore or at sea. One good example of induction and pickup problems is an echo-ranging sea unit in 95 feet of water receiving strong c-w signals at about 25 kc.

Constructive thinking on the harbor defense problems must continue. The present system is by no means the final answer. Every effort is being made, however, to evaluate present ideas and requirements, cooperate in the development of new devices, and to give and accept any advice or assistance that will help provide the U. S. Navy with the finest of Harbor Defense systems.

FIELD CHANGE FOR MODEL RBO RECEIVER

On page 1 of the bulletin of instructions supplied with Field Change No. 2 for model RBO radio receivers on Contract NObsr-30032, the new power transformer is inadvertently listed as T-111. The correct symbol is T-115. The bulletins and the instruction books for the modified equipments should be checked and corrected at the earliest opportunity.

BUSHIPS Electron

A MONTHLY MAGAZINE FOR ELECTRONICS TECHNICIANS

JULY, 1948 VOLUME 4 NUMBER 1

In line with its policy of bringing field activities closer together, the Bureau of Ships desires the Naval Shipyards to take cognizance over the material content of certain issues of BuShips Electron, *one issue assigned to each shipyard, the shipyard to provide photographs and text for the bulk of the issue.*

The Mare Island Naval Shipyard kindly consented to do this for the July issue of Electron. *The Boston and San Francisco yards will contribute heavily to the August and September issues, respectively. Other activities, shipyards and laboratories alike, will follow this lead in subsequent issues.*

DISTRIBUTION: BuShips Electron, is sent to all activities concerned with the installation, operation, maintenance, and supply of electronic equipment. The quantity provided any activity is intended to permit convenient distribution—it is not intended to supply each reader with a personal copy. To this end, it is urged that new issues be passed along quickly. They may then be filed in a convenient location where interested personnel can read them more carefully. If the quantity supplied is not correct (either too few or too many) please advise us promptly.

CONTRIBUTIONS: Contribtions to this magazine are always welcome. All material should be addressed to

The Editor, BuShips Electron
Bureau of Ships (Code 993-b)
Navy Department
Washington 25, D. C.

and forwarded via the commanding officer. Whenever possible articles should be accompanied by appropriate sketches, diagrams, or photographs (preferably negatives).

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BuShips Electron contains information affecting the national defense of the United States within the meaning of the Espionage Act (U.S.C. 50; 31, 32) as amended.

BUREAU OF SHIPS — NAVY DEPARTMENT

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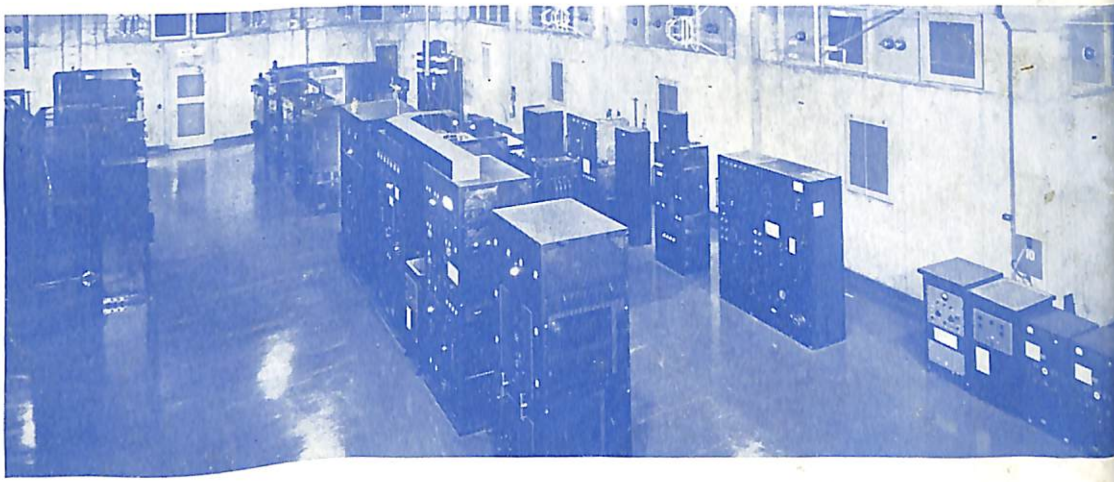
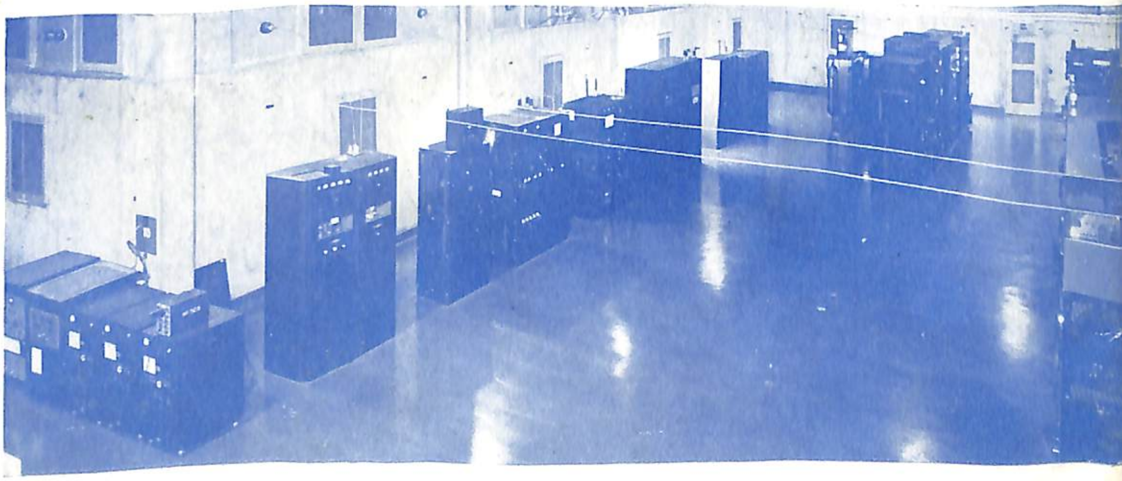


WING "A" FROM ROOF OF CONTROL ROOM

WING "B"



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