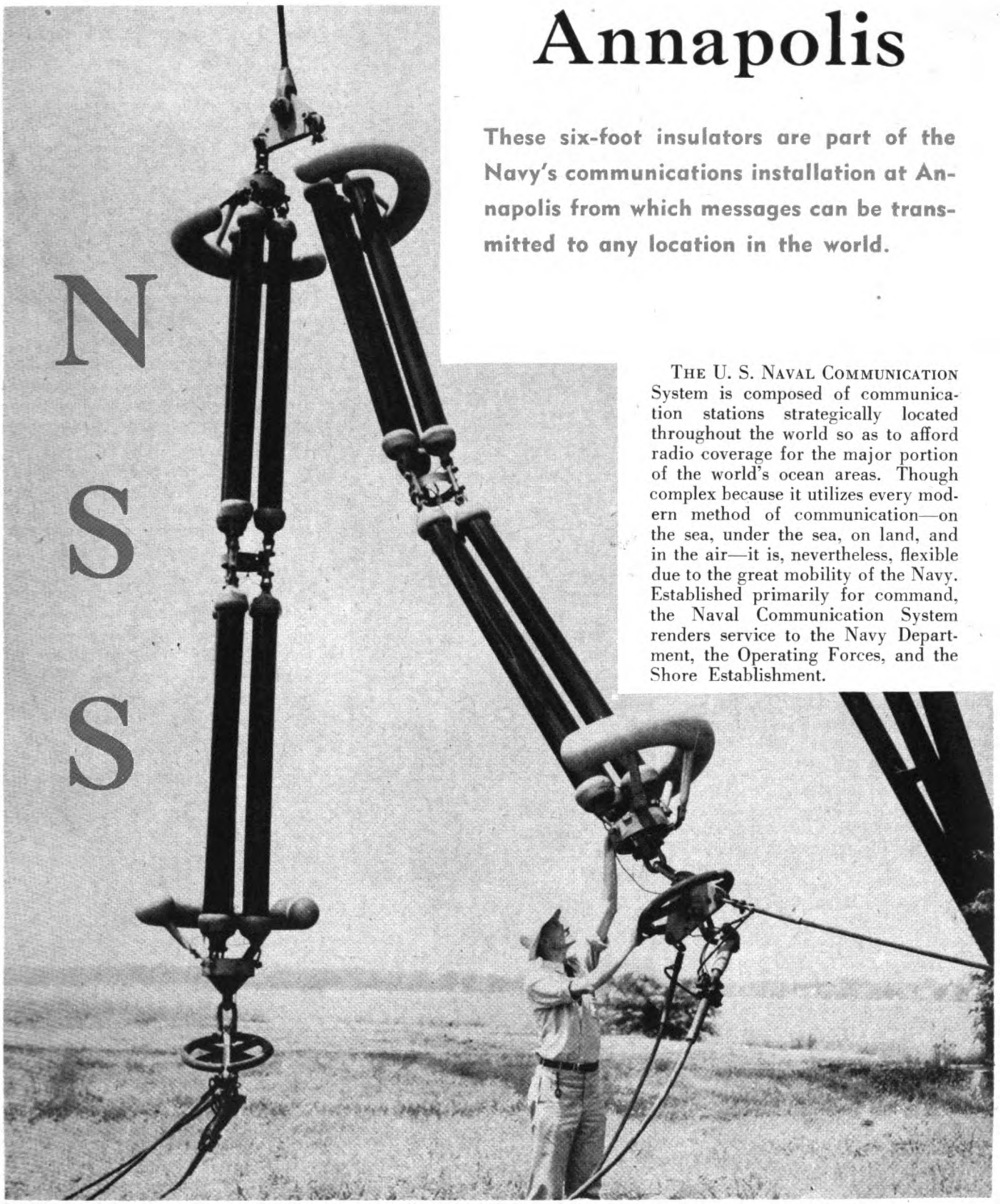
# Naval Radio Station

## Annapolis

**These six-foot insulators are part of the Navy's communications installation at Annapolis from which messages can be transmitted to any location in the world.**



THE U. S. NAVAL COMMUNICATION System is composed of communication stations strategically located throughout the world so as to afford radio coverage for the major portion of the world's ocean areas. Though complex because it utilizes every modern method of communication—on the sea, under the sea, on land, and in the air—it is, nevertheless, flexible due to the great mobility of the Navy. Established primarily for command, the Naval Communication System renders service to the Navy Department, the Operating Forces, and the Shore Establishment.

The shore communication facilities serving the Navy Department have become representative of the entire Naval Communication System. For administrative and command purposes, the communication centers have been combined with other activities performing associated communication functions to form naval communication stations (NAVCOMMSTA). Operationally, communication centers normally are composed of: a message center, a cryptocenter, a relay station, and radio stations.

### NAVCOMMSTA Washington, D. C.

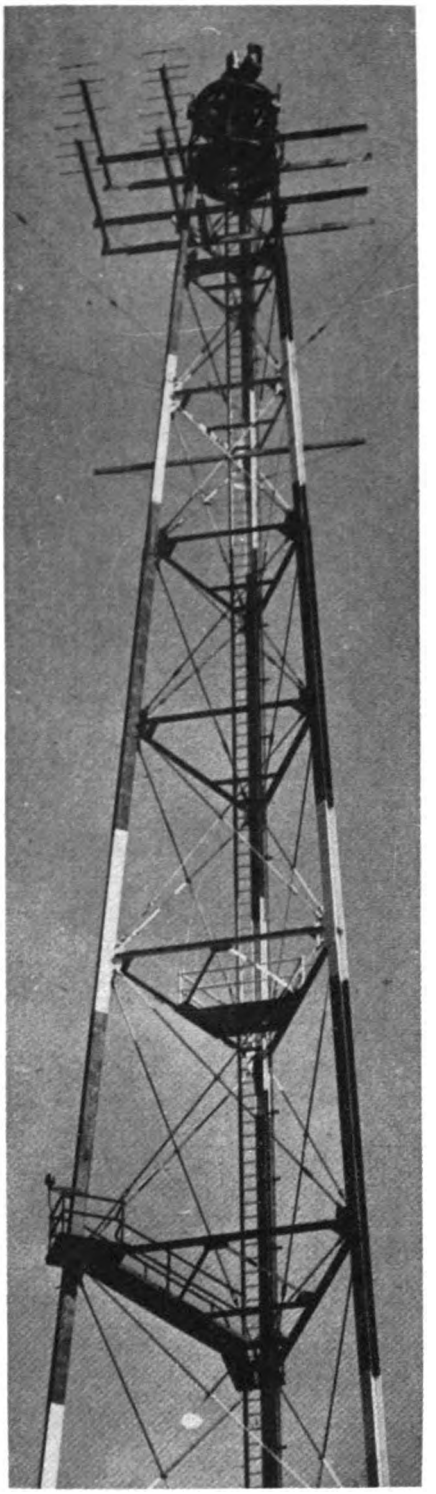
The U. S. Naval Communication Station, Washington, is under the military command of the Commandant, Potomac River Naval Command (PRNC), for those components located in PRNC. Those components located in the Severn River Naval Command (SRNC) are under the military control of the commandant of this command. Management control is the responsibility of the Chief of Naval Operations (CNO), through the Director, Naval Communications (DNC).

As the nerve center of the highly organized communication network, the U.S. Naval Communication Station, Washington, is composed of the communication center which operationally includes the message center, cryptocenter, and relay station located in the Navy Department Building in Washington, D. C. together with the naval radio stations (NAVRADSTA) in Annapolis, Maryland; Arlington, Virginia; and Cheltenham, Maryland: and the Registered Publication Issuing Office (RPIO). NAVRADSTA (R) Cheltenham is the receiving station, whereas the others are transmitting stations.

Through the facilities of the Naval Communication Station, Washington, the Navy Department has immediate contact with all its forces throughout the world.

### Transmitting Station

The importance of the role of the U. S. Naval Radio Station (T), Annapolis, Maryland, is apparent when it is realized that it serves as the voice of the nerve center of the world's largest Naval Communication System. Initially commissioned in 1918, the station was referred to as a high-powered station. The name has survived as a local designation, attributable to the 500-kw. VLF transmitter and associated equipment. The transmitting antenna, supported by nine 600-foot steel towers, constitutes



Radio link antennas under construction.

a unique landmark. In addition, there is a veritable forest of bare poles supporting antenna wires, coordinated by rows of poles carrying an increasing number of radio transmission lines to the two large transmitter buildings. At its commissioning, NAVRADSTA Annapolis (NSS) became the highest powered station in a series of eight major Navy radio stations commissioned during the period 1913-1918. One of the transmitter buildings and four of the steel towers have been in continuous use since 1918 when NSS was commissioned with two 350-kw. arc transmitters. Later, the Navy began using vacuum tube transmitters at major stations. The NSS arcs were decommissioned in 1934 and replaced by the 500-kw. vacuum tube VLF transmitter.

### Very Low Frequency Transmitter

The 500-kw. VLF transmitter operates on a wave length of approximately ten miles. The tower-supported antenna is some 1000 feet wide by 4000 feet long. Its physical characteristics are kept fairly constant by means of tower counter-weights totalling 100 tons. There are approximately 10 miles of cable in the antenna alone while the antenna covers approximately 100 acres.

The transmitter proper is housed in an aluminum bungalow with four house-size doors for access. Amplifier tuning coils are so large that men go inside them for close inspection. The ceiling of the helix house adjacent to the transmitter is 50 feet high to accommodate the huge antenna tuning coils wound with Litz cable. Two cables in parallel, each two inches in diameter, are required to carry the enormous antenna current. Such a strong radio frequency field exists near the coils that fluorescent bulbs light up when held in one's hand, and a nearby grounded water pipe and a grounded metal conduit can be shorted, causing a blinding flash. At full power, the antenna downlead, some 35 feet above ground, has 250,000 volts RMS present. Average voltage per foot between downlead and ground is some 7000 volts. Persons wearing nailed leather shoe soles have had their feet burned walking near this field. Once a mounted marine sentry, passing the downlead at some forty feet, suffered a flesh burn where his leg lay against a harness buckle.

### High Frequency Transmitters

Most of the station's service is performed by the less spectacular high frequency transmitters, rated between 2- and 40-kw. output. Adjustments of these transmitters are made manually and by servo-mechanisms. To cool the transmitters, both forced air and water cooling systems are employed. However, the water cooling systems are becoming obsolete as larger air-cooled transmitter tubes are perfected. Heat from both cool-

ing systems is currently used during the winter months to heat the transmitter rooms.

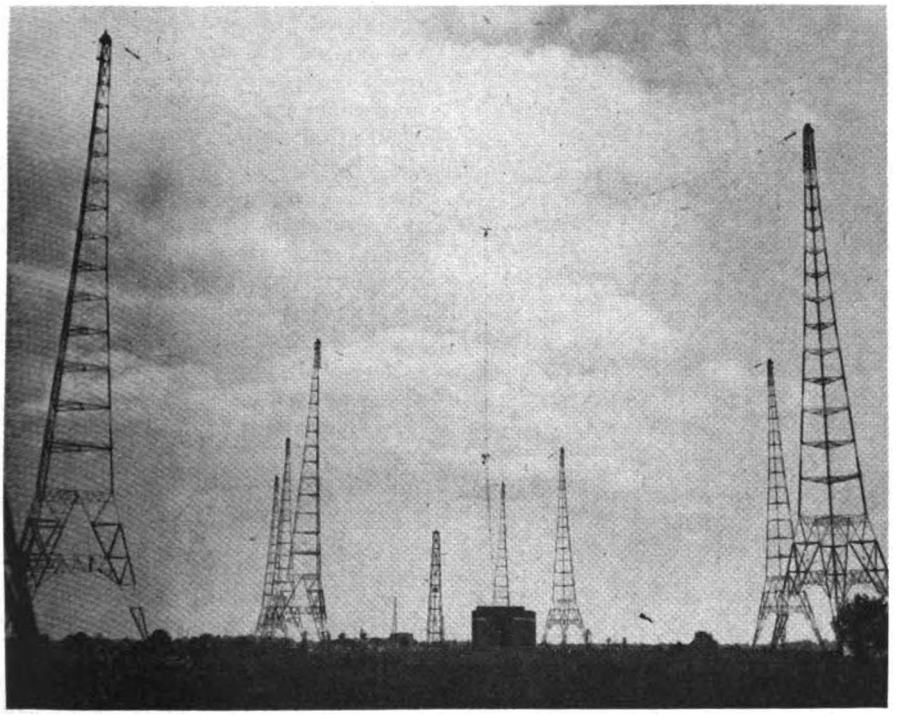
To effect the transoceanic and transcontinental transmissions, the transmitting station at Annapolis is equipped and manned as an automatic traffic relay point. Communications are translated to low or high frequencies as required, and considerably amplified in power prior to transmission.

Since long-distance transmitting service is supplied continuously, transmitters of suitable power must be furnished promptly on the specific operating frequencies when requested by the Naval Communication Center, Washington, D. C. At the same time, antennas designed for the operating frequencies and the geographical service areas must be provided. Facilities and personnel must be in constant readiness to restore immediately transmitting service with stand-by equipment in case outgoing communications are interrupted because of equipment failure. To meet present service requirements, some 60 radio transmitters and 100 antennas of various types are in commission. (However, the future operating requirements are such that a new windowless, air-conditioned, strictly functional transmitter building, and its associated antennas, including one 800-foot tower, is being constructed.) To provide against individual transmitter or antenna failure, and to meet broad military requirements, a high degree of flexibility in joint antenna-transmitter employment is obtained with radio frequency transmission line-switching stations. These rugged, highly practical installations are a significant operational feature. While antennas are the point of departure of the radio signals, the incoming communications arrive via radio link or landline at the terminal equipments. The terminal facilities form another system which requires precise adjustment before long-distance radio communications can be effective. On one point-to-point communication circuit, i.e., from the Naval Communication Station, Washington, D. C., to the Naval Communication Station, Pearl Harbor, there is perhaps the most complex aggregation of electronic and auxilliary equipment in continuous, co-ordinated operation in peacetime.

### Facilities and Services

NSS serves the Navy Department continuously with varied types of communications. Outstanding advances have been made since the transmitters were first manually keyed over direct current control lines from Washington to Annapolis. The use of keyed audio-frequency tones, in place of direct current keying, has overcome distance limitations of remote transmitter keying and achieved the necessary precision of the tone pulses to make automatic teletypewriter and multiplex transmissions reliable. Facsimile transmissions are now routine; these and radio-teletypewriter signals are transmitted by frequency-shift methods that improve the reliability of long-distance transmission equivalent to a transmitter power increase of approximately 20 times. On major circuits, single-sideband transmitters are employed which are capable of transmitting six teletypewriter messages and one voice conversation at the same time.

VLF antenna; approximately 1,000 to 4,000 feet.



### Broadcast Service

Long-distance transmissions fall into the broadcast, ship-to-shore and point-to-point groups. By means of broadcasts, ships anywhere in the Atlantic and other areas served by NSS, receive communications without the need for breaking radio silence. Because ships may be just off the coast or thousands of miles away, and because no single radio frequency is suitable at all distances involved, the broadcasts are transmitted simultaneously on several frequencies. Reception on board ship may be on one or more of these frequencies as conditions require. The Atlantic Ocean Area lies over a broad range of bearings from Annapolis, and broadcast transmissions must be directed accordingly by suitable transmitting antennas. Marconi antennas and half-wave doublets in various arrangements are suitable for this service. The doublet antennas may be single-wire antennas oriented parallel to the average coastal direction, or may be a suitable directional antenna array increasing transmission to seaward while reducing transmission inland. Broadcasts and individual ship-to-shore transmissions still employ the original continuous-wave, or carrier-on/carrier-off, method of signaling, although frequency-shift is being used on some broadcasts.

### Point-To-Point Service

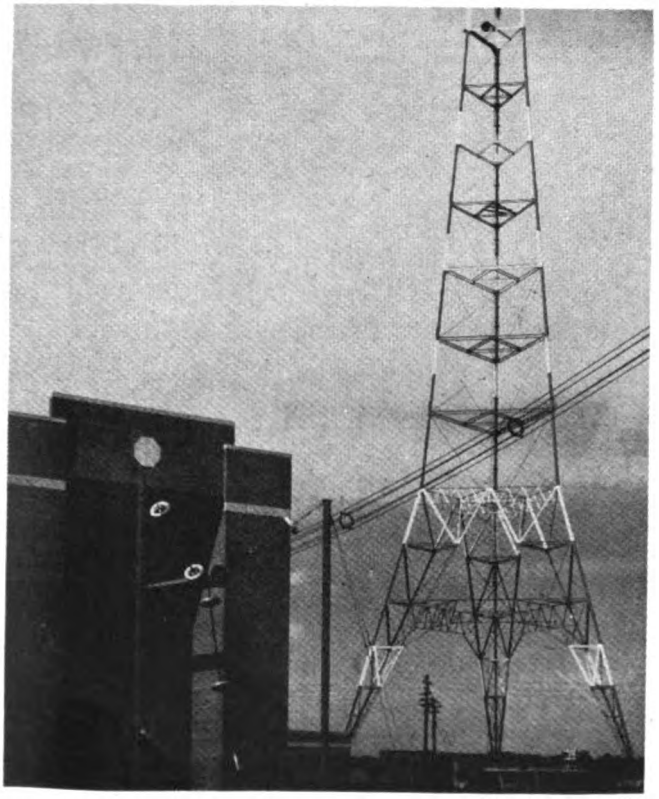
Contrasted to broadcast service, the point-to-point service requires the most concentrated radio beam transmission compatible with the frequencies employed. Where the broadcast service antenna covers an angular sector similar to a floodlight, the point-to-point service antenna must concentrate the radio energy like a searchlight beam. This is because the transmission is to one single geographical point, usually on a single transmitting frequency, and a strong dependable signal is required, with a minimum of power consumption. Concentration of the signal is secured

by the use of a rhombic antenna, a structure some 200 by 600 feet or longer, carefully erected on the desired great circle bearing (i.e., shortest distance bearing) toward the distant radio receiving station. Each distant base, transcontinental or transoceanic, in direct radio communication with the Naval Communication Station, Washington, is served by one or more rhombic antennas. Transmissions to such bases include all messages destined for the ocean area for which the base serves as a communication center, and for more distant points for which the base serves as a traffic relay point.

Gilbert Madrig, RM-2, tunes intermediate power amplifier, part of the 500-KW equipment at NAVRADSTA (T) Annapolis.

### Recent Developments

Facsimile is a relatively new high frequency service. When a Navy task force went to the Antarctic in 1948, the pictorial news of the expedition came by Navy facsimile transmission. Transmission by facsimile of certain printed material, charts, and weather maps is now well established. Under some conditions of interference, this method of transmission is superior to radioteletypewriter. The latter is transmitted by a series of pulses, the loss of one of which may garble a character. Under conditions of intermittent interference many characters may be lost. In facsimile transmission, the printed material is scanned several times per line of printing. Parts of one or several scanning lines may be interrupted by interference without losing the intelligibility of the printed material. Prior to adoption of certain new communication equipment and methods, Naval Radio Station (T), Annapolis has taken part in field tests and evaluation, including micro-wave link equipment, transmitting antenna design, and refinements in long-distance communication methods.



Down lead entrance to Helix house, 500-KW transmitter. The tower is one of nine 600-foot towers.

### Overall Proficiency

Operating frequencies are maintained at Annapolis to the Navy tolerance of plus and minus 0.003% in the high frequency range, by periodic check measurements made at the station. In addition to maintaining transmitter frequencies within tolerance, and checking for normal operation and performance of transmitters, operating personnel maintain surveillance over the terminal control equipment and associated link receiving equipment to insure continuous operation. Suitable signal levels at Annapolis rely upon close signal tolerance maintained at the Naval Communication Station, Washington and the VHF transmitting station, Arlington. Equipment failure or maladjustment at those points adversely affect ultimate transmission from the transmitters at Annapolis. However, through the coordination of the Naval Communication Station, Washington and mutual cooperation of operating and maintenance personnel at the three stations, the outages for outgoing communications due to personnel and equipment failures at Annapolis are remarkably small. The percentage of uninterrupted transmitter-hours service rendered annually by Naval Radio Station (T), Annapolis, Maryland, is of the order of 99 and 99/100% continuous.