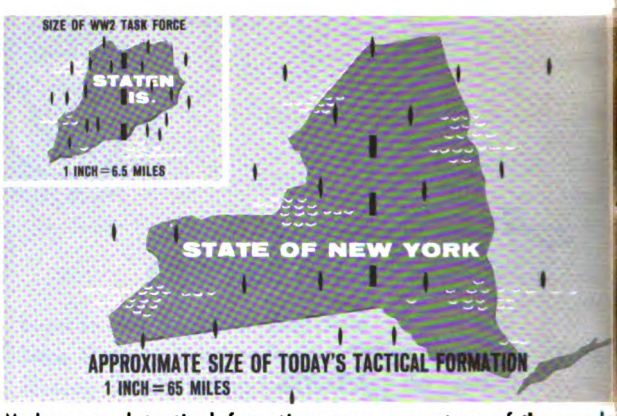
New COMMUNICATION SYSTEM For the Fleet



Modern naval tactical formations may cover tens of thousands of square miles of sea to minimize damage in case of atomic attack.

A combat ship in today's tactical formations may cruise for days without the comforting sight of a single other ship in its own task force. Contrasted to the World War II formations, grouped tightly within a radius of a mile or two for air defense, the modern naval formation may cover tens of thousands of square miles—occupying sea areas as large as the state of New York. A prime reason for the spreadout formation is obvious: to prevent one nuclear weapon from crippling an entire formation.

As a result of this dispersion of ships, a successor had to be found to the visual and line-of-sight radio techniques widely used in tactical communication. After scrutinizing the latest advances in the communication art, the Navy found a workable system that would meet the design goal of 300-mile continuous coverage with nearly perfect reliability.

Now Is the Time for Sacrifice

By RAdm. R. K. James, USN
Chief of the Bureau of Ships

As you are all aware, it is now necessary to carry on our operations with less people, while the workload remains at the same or a higher level than in the past. The leaders of our Government have more and more pointed to the need for personal sacrifice on the part of all Americans, if this Nation is to endure as the world's greatest hope for that form of government which holds that the protection of the rights of the individual citizen is the primary reason for which governments are instituted.

Some of the sacrifices often referred to are now materializing. The years ahead are fraught with danger and difficulty, and we in the Bureau of Ships organization must be equal to the challenges presented to us. Recent personnel reductions accepted by the Navy in the field activities and in the headquarters establishment will clearly impose additional burdens upon us all.

This is not a time for grumbling, bickering or complaining. This is a time for redoubled effort in the highest tradition of the naval service. I call upon all of you as dedicated Americans and loyal supporters of the Navy to rise to the new challenges now facing us. Each of us must assume new responsibilities and contribute more of our time and energy to carrying out our mission. We must look ahead, not back. We must determine to do whatever is necessary to support the Fleet with all the multiple requirements which it needs to remain the world's greatest seagoing deterrent to war.

I am confident that I can count on each of you as individuals to put forth greater effort to accomplish the momentous tasks that lie ahead. I know that as members of the Bureau of Ships' team, each of you will give an account of yourself of which we can all be justifiably proud.

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This system utilizes the greater effective talking power of single sideband (SSB) emission.

The full potential of SSB is being felt now with the phasing-in of the AN/URC-32 HF transceiver, the new standard HF medium power equipment for the Navy's combat ships. Modified from a commercial design for Navy use, this transceiver offers continuous coverage of the 2- to 30-megacycle range in 1-kilocycle increments (500-cycle increments in CW and FSK modes) with a minimum rated power output of 500-watts PEP.

The AN/URC-32 had a test of its capabilities during LANTFLEX, a large-scale Atlantic exercise of the U.S. Second Fleet last fall involving about 23 ships from ports along the eastern seaboard. During the extended exercise a task force of carriers, guided missile cruisers, destroyers, submarines, and supporting fleet oilers was engaged in antisubmarine, air defense, and electronic warfare. The AN/URC-32 had been retrofitted in all but a few of the ships in the task force's HF SSB tactical communication net.

Coverage

Throughout the exercises the AN/URC-32 showed its capability of the desired solid ground wave coverage. The AN/URC-32 also performed well consistently on long-range contacts via ionospheric propagation, although there were not enough operations during the exercise to form the basis for any general performance statements.

As frequently happens with this type of communication, some interesting twists developed. A radio check was being performed with AN/URC-32 installation at the pier at Norfolk Naval Base. The operator, thinking he was talking to a local shore station, got a signal report, but was more than mildly surprised to learn he was actually in communication with another AN/URC-32-equipped ship in the Mediterranean.

Although there was concern in some Navy quarters that the increased complexity brought on by the advanced performance of the AN/URC-32 would lower the reliability, the opposite actually proved to be the case.

A Bureau of Ships tabulation for the first 26,000 hours of operation of AN/URC-32's indicated outage time was much less than one-half percent. This heightened reliability can be attributed to the reliability program which ran concurrently with the design of the equipment and continued through production and actual field application.

Power vs. Weight Advantage

The AN/URC-32 program has brought several innovations into the Navy communication picture: Full use of SSB; light, compact equipment design; modular construction; transistorized circuits; and installation by the forces afloat. With the AN/URC-32, the Navy now has equipment with the stability, reliability, and performance to take effective advantage of advanced SSB techniques.

Single sideband offers spectrum conservation and reduced interference and noise levels through narrow bandwidth; freedom from signal distortion caused by selective fading, and greater effective talking power resulting from concentrating all transmitter power capacity in the essential sideband intelligence. This power advantage, plus improved circuit and mechanical design, gives the AN/URC-32 a very favorable power-vs.-weight (or power-vs.-size) ratio when compared with previous equipment—a critical matter on modern warships. Weight of the complete AN/URC-32 transceiver is only 390 pounds, compared to typical weights of 700 to 800 pounds on previous AM transmitters alone.

Modular construction has simplified the job for the electronics technicians (ET). Functional division of the transceiver's circuits into standard modules with numerous test points helps the ET to isolate any malfunctions readily. A defective module can be removed and a spare plugged in immediately to minimize outage time. The original module can then be repaired at a convenient time or sent ashore to a repair facility. This maintenance technique is especially helpful at sea during battle conditions or when rough weather makes repair work difficult at best.

Another construction technique fairly new to shipboard application is the use of printed wiring boards in many of the modules for mounting components.

Semiconductors are employed widely in the

AN/URC-32 HF SSB transceiver is demonstrated to Capt. Harold G. Bowen, Jr. (left), Commander of the USS *Northampton*, by the ship's Electronics Material Officer, Lt. H. Criner.

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USS *Roosevelt* was one of two carriers of the Second Fleet taking part in exercise LANTFLEX. The exercise included operations in air defense.

design to improve reliability and reduce size and power consumption. For example, the transceiver's frequency standard is completely transistorized, and the high voltage power supply uses silicon diodes instead of bulky mercury vapor tubes.

The configuration of the AN/URC-32 has enabled the Navy to effect savings in time and money by having the forces afloat install their own systems, rather than taking the ship to a shipyard for retrofitting. Because of light weight and easy disassembly, the equipment can be readily carried aboard ship without special loading equipment. Since internal interconnections are wired at the factory, installation involves little more than fastening the shockmount and swaymount; replacing the rack shelves and plugging in the interconnecting cables; and making the necessary power, RF, and remote connections.

Complete System

The AN/URC-32 is a complete system mounted on a single 19-inch, open-type rack, with space for an associated antenna line tuner or antenna coupler control. A built-in dummy antenna and transistorized microphone are supplied with each AN/URC-32. The transceiver may be used for transmission and reception on upper sideband, lower sideband, twin sideband, two independent sidebands, compatible AM (carrier reinserted), CW, or FSK. It may be easily tuned to a new frequency in 2 to 3 minutes by an experienced operator using the simple front panel controls.

The power amplifier is a two-stage design with RF feedback for linear performance. Manually tuned in four bands, it amplifies an excitation signal from the frequency generator unit to a nominal 500-watts PEP and applies it to a 50-ohm antenna transmission line.

The frequency generator unit is used in common for transmitting and receiving, translating the 300-kilocycle IF signal from the sideband generator unit to the desired operating radiofrequency in transmission and vice versa in reception. The multiplicity of injection frequencies required for coverage of the 2- to 30-megacycle range in 1-kilocycle increments is obtained by a stabilized master oscillator. This oscillator is controlled by the AN/URC-32's self-contained frequency standard so that the transceiver has an over-all frequency stability of 1 part in 10^8 per day. The frequency generator is manually tuned to the desired operating frequency in one of four bands by operating a direct-reading, counter-type dial.

Sideband generation and detection take place in the sideband generator unit. The AN/URC-32 uses a balanced modulator, which is fed a 300-kilocycle carrier derived from the frequency standard. An appropriate mechanical filter provides the selection of the desired sideband from the double sideband, suppressed carrier output of the modulator. Separate balanced-modulator and mechanical-filter combinations are used for each sideband, and where AM compatibility is desired, the 300-kilocycle carrier may be reinserted. In reception, separate IF/AF amplifier modules are provided for upper sideband, lower sideband, and AM. These modules amplify, filter, and demodulate the signal from the frequency generator unit.

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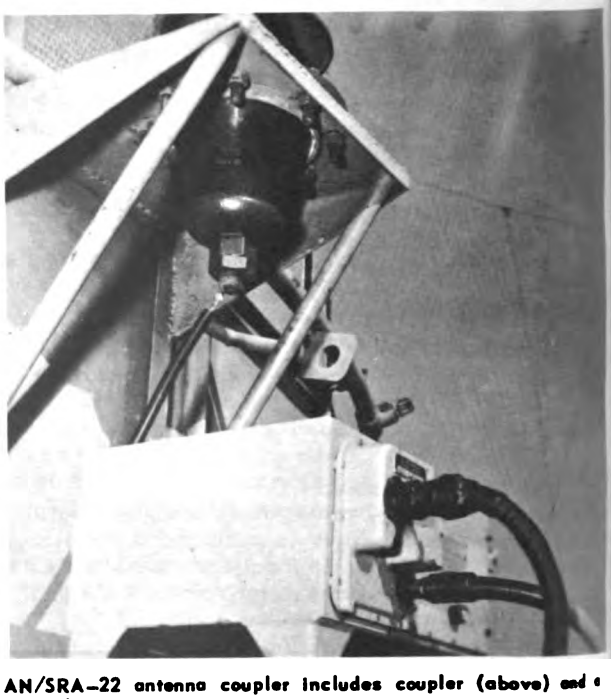

AN/SRA-22 antenna coupler includes coupler (above) and control unit.

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Communication System

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The AN/URC-32 is equipped with a CW and FSK unit which may be used to supply audio tones to the balanced modulator in accordance with CW keying or teletypewriter mark-space information for transmission. In reception it provides a BFO output signal. The transceiver system also includes a frequency comparator which enables checking the transceiver frequency standard against an external standard or Bureau of Standards radio signal.

The AN/SRA-22, antenna coupler group, is normally used for tuning the antenna and matching it to the 50-ohm transmission line with high efficiency over the 2- through 30-megacycle range in surface ship and shore installations. The group includes two units: the actual coupler, which is packaged in a weatherproof case and mounted at the base of the antenna; and the coupler control, which is mounted on the transceiver rack. The coupler network includes a variable and tapped coil and variable vacuum capacitor, all positioned by motors and controls operated remotely by means of the coupler control.

On some ships the AN/URC-32 operates into an antenna multicoupler and on submarines it feeds a standard submarine antenna tuning group. To match the transmission line and VSWR variances to the transceiver power amplifier in these cases, a CU-737/URC monitor coupler is used.

SSB for All Combat Ships

The Navy undertook studies of single sideband in the early '50's to determine if it could satisfy the tactical communication requirements of the dispersed formations. An early fleet SSB capability was achieved by procuring off-the-shelf equipment types available at the time; but the Navy continued its search for equipment with the desired stability and performance for effective tactical application of SSB. When the Collins Radio Company developed its commercial KWT-6 transceiver, the Navy subjected it to extensive laboratory tests and operational use at sea and, after modifications to adapt it to shipboard communication systems, the KWT-6 became the AN/URC-32.

Comprehensive programming and inter-agency coordination helped smooth the transition to the new equipment. Some of the first units off the production line went to Navy training schools, so that personnel could be trained in operation and maintenance of the equipment. Early in the procurement stage also, a factory training school was set up, as well as special schools aboard ship and at major ports. The Electronic Supply Office worked closely with the Bureau of Ships so that the necessary support could be provided as the units went into service.

Arrangements were made to procure a complete set of spare modules concurrent with each installation, as well as a tool kit, test harness, and pendant cables, so that ships' electronic technicians would have the means to maintain the equipment from the start. When the supply permits multiple installations on some ships, the original module and tool kits will also serve the additional transceivers.

The Navy has established repair facilities on each coast with the specialized test equipment required for production line overhaul, repair, and test of modules.

To date, the transceiver is providing communication service with the Fleet all over the world. During the official opening of the St. Lawrence Seaway last summer, an AN/URC-32 aboard the destroyer USS *DuPont*, which was escorting the Royal Yacht *Britannia* carrying President Eisenhower and Queen Elizabeth, relayed direct reports from news commentators to New York for network broadcasts. In a similar application, the AN/URC-32, was used to send news broadcasts during the President's visit to the Mediterranean and the Sixth Fleet, and during his tour of South America.

Units are programmed for installation on Navy combat ships—carriers, cruisers, destroyers, submarines, and radar picket ships—as well as on ships of the amphibious forces.—Condensed from Collins *Signal*, Volume VIII, No. 2, 1960.

Journal Bearing Clearance For Forced Draft Blowers

Abnormally high use of stock bearings for the Westinghouse turbine-driven forced-draft blowers on DD-445 and DD-692 classes of destroyers has been attributed to replacement of bearings that are actually satisfactory for further service. The situation results from the fact that bearings are replaced when the clearances exceed the 7-10 mil clearance specified on figure 9 of the applicable technical manuals (NavShips 353-0006, 353-0016, 353-0021, and 353-0036).

The manufacturer has advised, however, that the 7-10 mil clearance is that expected when new parts are assembled, and that a bearing having this clearance is equal to a new bearing. The manufacturer has also indicated that clearances up to 15 mils on the diameter are considered satisfactory, providing other conditions are normal.

It is recommended that suitable notes be inserted in the technical manuals and pertinent records to indicate that replacement of these bearings is *not* mandatory until the clearance exceeds 15 mils on the diameter. The 15-mil figure is to be used only as a guide, since bearings should be replaced before this limit is reached if abnormal operating conditions can be traced to a bearing clearance which is too large.

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