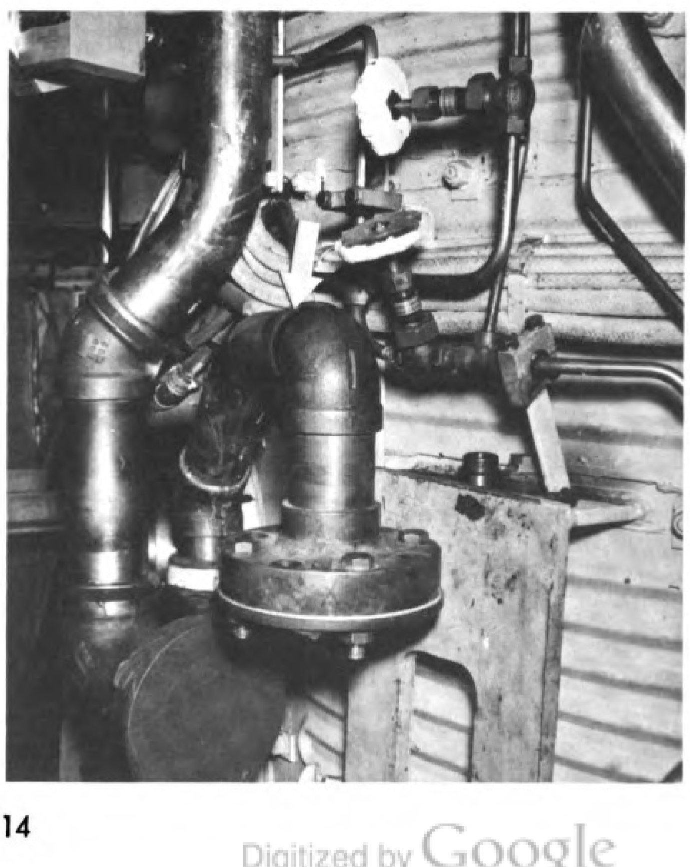
16 x 21 inches and weighs 86 pounds. It can be easily lowered through submarine hatches and can reach any piping joint on the ship. This 10-kc, 30-kw remote-station equipment has been successfully used to braze copper-nickel to bronze and copper to bronze joints ranging from ½ inch to six inches IPS. The remote station can also be used on 50-kw and 100-kw M/G power sources provided the output voltage of the generator is 220 volts or a step-down transformer is used.

The induction coil used with the remote station is made up of .250-inch copper tubing over which a glass insulating sleeving is installed. The inductor coil can be made in various shapes and numbers of turns ranging from three to eight with good results. The turns can be made in two tiers to increase the induced heat in a small area. The internal diameter of the turns of the inductor coil are of the same size to enable the brazer to work the coil to any area of the fitting and pipe. This technique, similar to torch brazing, is used to apply the heat where it is required for optimum flow of the alloy, thereby resulting in an excellent bond between the pipe and fitting. It also reduces the number of inductor coils required for different wall thicknesses of pipe. The winding of the inductor coil is not critical.

Figure 8. A joint which was brazed with remote induction station without removing electrical cables. Over 300 man-hours ripout was saved on this job.



The original induction brazing work at Portsmouth consisted of comparing two different frequencies for production brazing; i.e., 10-kc and 450-kc frequencies. After considering the advantages of each, the Shipyard chose to pursue the 10-kc equipment. A major advantage recognized was that the lower frequency equipment was much safer. The comparison tests also showed that the 10-kc equipment was rugged and reliable and could be easily adapted for remote-station brazing. The lower-frequency equipment also proved to be quite suitable for using split-type inductor coils for both shop and remote brazing. The split-type coil can readily be opened into two half circles and easily closed around the joint. Presently, all shop brazing stations are equipped with a complete set of split-type inductor coils capable of brazing any joint which can be brought to the machine.

Presently, Portsmouth Naval Shipyard is developing induction-brazing systems using 100-kw, 10-kc power sources, each equipped with six remote stations. With this arrangement, as many as four stations can be used simultaneously.

Project Southern Cross

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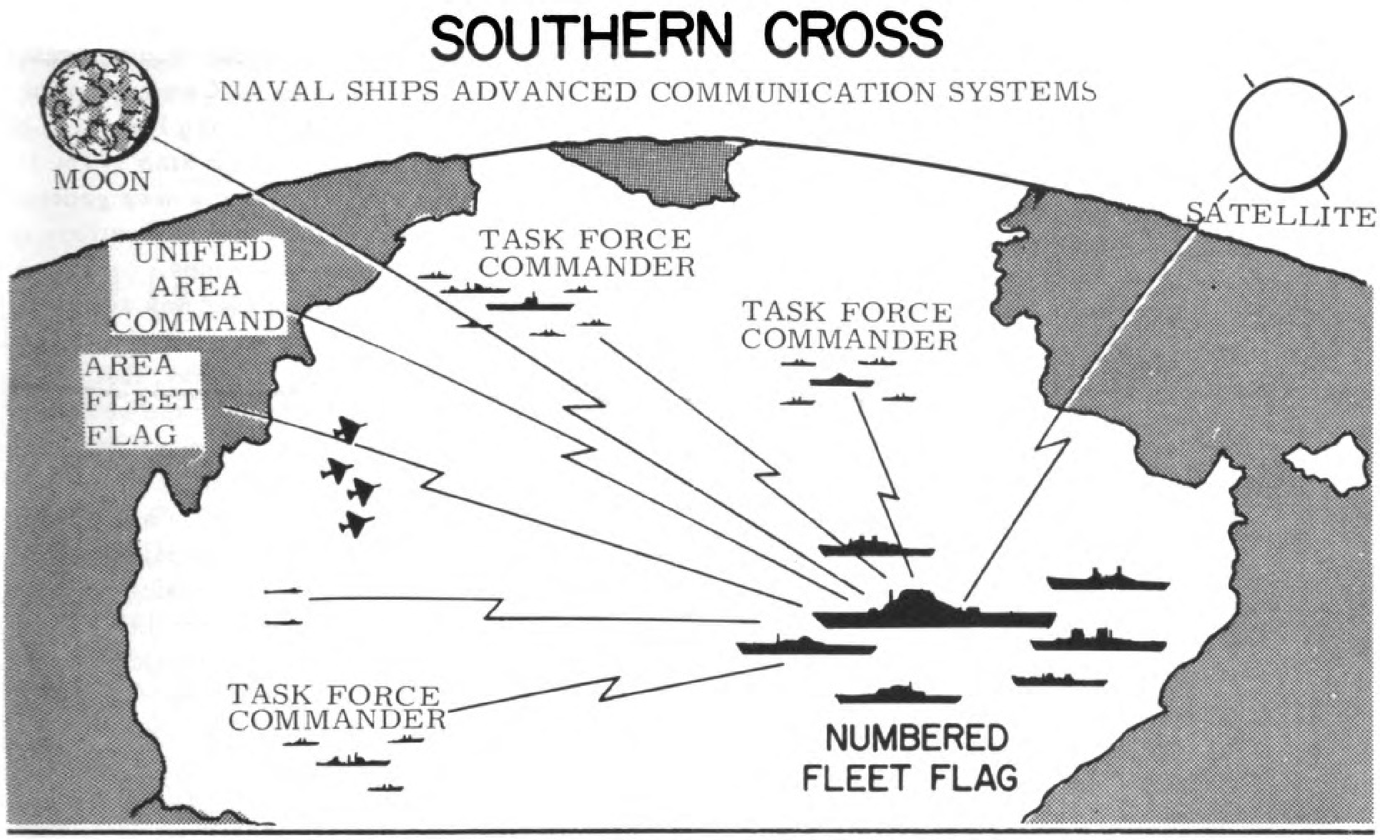
Southern Cross (Naval Ships Advanced Communication Systems) is the Bureau's most far-reaching communications research and development project. It is aimed toward significantly improving naval communications in the 1970's and beyond through development of the integrated shipboard communication system.

In its broadest sense, the naval communications system consists of subsystems which meet the requirements of specific individual users ashore and afloat in a variety of locations world wide. Project Southern Cross is concerned with Naval Ships Advanced Communication Systems on the whole spectrum of surface ship platforms from the smallest to the largest.

The most severe problems in shipboard communications result from constraints imposed by the ship itself. Antennas for sensitive receivers must often be placed in the near field of high power transmitter



Scope of Project Southern Cross.

antennas. A startling number of intermodulation products or beat frequencies can be generated by electrical nonlinearities in the ship's structure when two or more transmitters are keyed simultaneously. In the modern shipboard communications environment, five or more transmitters are often operating in the high frequency spectrum alone. The resulting cross-products can number in the thousands, with a high probability of self-jamming receiving frequencies.

With its equipment on mobile platforms, the Navy has usually resorted to omnidirectional antennas radiating equally in all azimuths, which often turn out to be anything but omnidirectional. The traditional and still frequent reliance on voice and keyed radio-telegraph is wasteful of the electromagnetic spectrum, requiring more bandwidth than the information exchange rate justifies.

The communications installation on the modern ship has grown larger and more complex. In many cases, communications equipment is a collection of black boxes, each developed as the result of an evolving operational requirement, installed to meet a particular need, and now often obsolescent. Regardless of how good the newer component black boxes are, communication equipment developed and installed in such a way is plagued by mutual incompatibilities.

Southern Cross will provide a systematically organized set of communications suits designed to fit on naval ships and tailored to meet different afloat user requirements. An essential part of the Southern Cross effort is extensive investigation into the real communications requirements of various levels of command: the Numbered Fleet Commander, the Amphibious Task Force Commander, the destroyer skipper, and others. The customary practice of stating these requirements in terms of numbers of channels or numbers of transmitters and receivers is being avoided; the Navy studies are getting to the heart of the matter: Who needs to transfer what kind of information to whom, how far away, and how often?

For each user, the Navy will assemble an integrated communications suit made up of replaceable functional modules. Part of the problem is determining how this can be done without suddenly outmoding the present communication equipment investment of the Fleet.

Project Goals and Approaches

Modern computer techniques will be used to control the various parts of the shipboard communications system so that it can be adapted to the ship's electromagnetic and operational environment.

Priority information traffic will be processed in real time. Therefore, the optimum frequency and the appropriate modem and data rate must be selected.

Information must be exchanged between the ship, other naval operational commanders, support centers and special commands and national authorities as the situation demands. Distances can range from line of sight up to 12,000 miles. A mix of ground wave, ionospheric reflection, tropospheric scattering, and active and passive satellite radio paths will be required.

Within the ship, automation must be applied to message and data processing, filing, routing, forwarding, and all the administrative things done with messages. The naval commander must have rapid access to his message files. The nature of information to be exchanged must be examined. A display on a NTDS console is really a communication; perhaps other information now routed on ships as hard copy could better be placed in front of the user in different form.

Automated equipment fault location and, in some cases, automatic fault correction is essential in future installations of naval communication systems. Reliability and maintainability must be viewed from the standpoint of system availability and total system effectiveness. Along with this concept goes the need to improve and standardize electronic packaging as to physical form and electronic function, and the need to develop better environmental testing techniques.

Project Organization

The technical execution of Project Southern Cross is coordinated by the Bureau of Ships in the Communication and Computer Design Branch of the Electronics Division. The major part of the technical effort is now being performed at the Navy Electronics Laboratory, San Diego. NEL has about 90 people working on Southern Cross, as well as nearly 40 active NEL contracts. The Naval Research Laboratory and the National Bureau of Standards are also participating in the project. As time passes, the emphasis of the project will shift from R&D to manufacture and installation and, therefore, more and more back to the Bureau of Ships.

The present initial phase of Southern Cross can be thought of as three concurrent efforts. *Operations research into the communications requirements* of various levels of command is giving a whole new approach to naval communications. Recently completed is a detailed analysis of the requirements of the Numbered Fleet Commanders, Commanders of the First, Second, Sixth, and Seventh Fleets. The results of these studies will permit start of the first system design. Further studies of a more general nature are now underway of the communications requirements of fleets, forces and ships.

The Numbered Fleet Commander was selected because his flagship's problems are so severe and his communications demands so heavy, that if Southern Cross can assist him, then the solution can be scaled down and applied to many other ships.

Concurrently, extensive *state of the art studies* are being made into antennas, receivers, transmitters, self-generated interference, propagation, modulation techniques, automatic processing techniques, and reliability and maintainability. These studies, as well as the operations research part of the project, are now being concluded.

The third parallel effort is *construction of a full size model*, the Ships Advanced Communications Operational Model (SACOM). SACOM will be an operational mock-up of shipboard communications systems operating in their near-normal environment. An inactivated ship will be used as the SACOM test bed. The first developmental system will be assembled in the SACOM where it will be evaluated, technically and operationally.

Personnel from the Fleet, Fleet staffs, and training schools will be able to operate the Naval Ships Advanced Communication System, actually communicating with Fleet units. In SACOM, the system will be developed as an integrated operational system with operational users providing a feedback loop in the communications R&D process. In SACOM, the system should be developed to the point where it has a high likelihood of success. Then, from this improved system, a set of engineering plans and specifications will be prepared with which the Bureau can procure the prototype system. The first system will be for the Numbered Fleet Commander. Using the same SACOM, subsequent systems will be assembled to meet the requirements of the destroyer, cruiser, carrier, amphibious force command ship, and others.

Project Southern Cross is the newest, most imaginative approach to naval communications R&D: the total shipboard communication system incorporating the latest in the state of the art; a set of functionally modular building blocks for flexibility in installation, maintenance and system up-dating; a system functionally validated before procurement. The pay-off will be more effective communications for the Fleet at reduced installation costs, reduced logistic support cost, and reduced manning requirements.

Liquid Laser Developed

A new material for a liquid laser which operates near room temperature has been developed by the Navy Electronic Laboratory (NEL), San Diego. The material, a fluorinated chelate (Eu-trifluorothenoylacetonate) dissolved in acetonitrile, has a high-energy transfer efficiency and exhibits laser action without the special cryogenic equipment previously required for liquid lasers.

Dr. Erhard J. Schimitschek, of the NEL Optical Physics Group, reported the accomplishment before the chemical laser conference at the University of California, San Diego. Richard B. Nehrich, chemist, and John A. Trias, physical science technician, assisted Dr. Schimitschek in the new development and were co-authors of the paper describing the chemicals and techniques.

A bonus provided by the new chemical mixture is that it remains stable for a much longer time than the materials that require cryogenic techniques. Presently used chelate-solvent systems all suffer from the same shortcomings; shelf life in solution is only a few days, and for operation they have to be cooled to almost liquid nitrogen temperature.

Dr. E. J. Schimitschek (left) and R. B. Nehrich discuss laser equipment at the Navy Electronic Laboratory (NEL), San Diego.

Transistorized Training Aid Program

A series of articles entitled "Transistorized Training Aids" has appeared recently in the *Electronics Information Bulletin.* The training aid program on transistor circuits was initiated by the Bureau so that personnel could gain experience in making emergency repairs on this type of equipment without practicing on expensive modular assemblies designed for original equipment.

The training aid program presents the instructions for the design and method of parts mounting in five separate phases: Phase I, code keying oscillator (EIB 585); Phase II, amplifier (EIB 586); Phase III, AM radio (EIB 587); Phase IV, transceiver (EIB 592); and Phase V, FM receiver (EIB 631).

Although the circuits to be fabricated and assembled in this program are diversified and complex, they all have three points in common. They employ miniature and subminiature semiconductor devices as basic circuit elements. They are duplicates of modular assemblies or assemblies having unitized construction insofar as parts, material and compactness are concerned. Many of the parts can be used for all phases of the training aid program.

After completing this training aid program, personnel should have a thorough knowledge of the basic circuit elements and their applications. With this knowledge as a background, the technician need only study the new circuit elements and their applications to understand the operation of any transistor circuit. Of course, the technician should also have acquired the two general requirements for servicing and repairing this type of equipment. He must have a good knowledge of the theory, construction and design features of transistor circuits, and he must have sufficient mechanical skill to install, repair and maintain the equipment.

Additional procedures and techniques for mounting and soldering miniature and subminiature semiconductor devices onto printed wiring circuit panels are contained in section 2 of the *Electronics Information and Maintenance Book,* Navships 900,000.100. Before participating in this training aid program or attempting repairs on modular assemblies, personnel should carefully read the subjects described and illustrated in paragraph 3-8 of this section.

The five training aid articles printed in the EIB have been compiled into one article which will be published in NavShips 900,000.100 at a later date.