SECTION 1
ADMINISTRATIVE PLANNING CRITERIA AND PROCEDURES

1-1. OBJECTIVE.

An electronic facility consists of the electronic equipment and integrated components which are installed to perform specific functions. The complete facility includes the buildings and accessories as well as the electronic equipment. The establishment of an electronic facility or an improvement project to an existing facility starts as a project of "military construction," or of "minor construction"; or it may be a "special facility" where no construction is involved. The purpose of the project will be to meet an "operational requirement." The objective will have been reached and the operational requirement fulfilled when the installation of equipment is complete and fully operative.

1-2. RESPONSIBILITIES.

a. BUREAU OF SHIPS.—As directed by Navy Regulations, and in accordance with Chapter 67, BuShips Manual, the Chief of the Bureau of Ships exercises technical control of design, development, procurement, and installation of the electronic equipment which comprises an electronics facility at shore activities. The establishment of maintenance, repair, and overhaul policies which concern such equipment also is the responsibility of the Chief of the Bureau of Ships. Exercise of such control is through the "Maintenance Authority," as delegated in Chapter 67 and applies to: "offices of Industrial Managers, USN, and other shore commands which may be or have been delegated technical control over shore electronic installations. Installation in this instance applying only to the equipment comprising the electronic system and such environmental surroundings in which the electronic equipment might be located that could adversely affect its designed operational characteristics."

When as a result of an operational requirement a military construction project or an improvement project has been established, it becomes the responsibility of the Bureau of Ships to collaborate with the Management Bureau and Bureau of Yards and Docks and through the local Maintenance Authority or other Bureau of Ships representative, to collaborate with representatives of the Management Bureau or office and Bureau of Yards and Docks in the advance planning and development of the project.

b. MAINTENANCE AUTHORITY.—The Maintenance Authority is an Industrial Manager, or other shore command suitably equipped and manned, to whom the Bureau of Ships has delegated technical control over shore electronic installations. In accordance with the Basic Naval Establishment Plan, the Maintenance Authority's responsibility is to install and maintain shore-based electronics equipment; and to provide technical guidance in these matters, as requested, to all Naval activities in the district and to the Area Commander. In forward areas, major construction projects may be accomplished by "task assignment" to a Maintenance Authority of a major Naval District.

c. BUREAU OF YARDS AND DOCKS.—The area of responsibility of this Bureau extends to the design, development, and construction of the structures and facilities required for the electronic installations of the Shore Establishment. The Chief of this Bureau has delegated certain specific phases of his authority to the following representatives:

(1) District Public Works Officers, with duties which include planning, directing, and carrying out the Bureau of Yards and Docks technical program of design, construction, alteration, and inspection of construction within the boundaries of his Naval district.

(2) Directors, Overseas Divisions, who perform the same function as DPWO's for overseas areas not included in specific Naval Districts.

(3) Area Public Works Officers, who represent extension of the authority of Overseas Directors to specific remote overseas areas.

(4) Officer in Charge of Construction, (usually the DPWO in continental U.S., at overseas locations may be a separate office), who performs DPWO functions insofar as they apply to the specific contracts for which he is designated OICC.

d. MANAGEMENT BUREAU OR OFFICE.—In general, management bureaus or offices at shore activities act as the sponsors and may operate the electronic facilities. The Chief of Naval Operations (DNC) acts as the sponsor and management control office for facilities of the Naval Communication System. The Chief of the Bureau of Aeronautics exercises fiscal and management control over ground electronic facilities at air bases and stations which are not required for SERVICE WIDE operation. The Bureau of Personnel is the management bureau for activities which include

Fleet Submarine Training Centers, various schools, Naval Reserve Officers Training Corps, Naval Reserve Activities and for such activities as, for example, a fleet training center which is under the military command of Commander, Training Command, U. S. Atlantic Fleet.

1-3. SCOPE OF RESPONSIBILITY.

The provisions of this handbook apply to all public works projects and other projects involving electronic material at Naval shore activities under technical control of the Bureau of Ships. Technical control of the installation of the electronic equipment which implements an electronic facility is exercised by the Bureau of Ships. Project construction pertaining to electronic facilities is primarily the responsibility of the Bureau of Yards and Docks and must meet the requirements of both technical and management bureaus and offices.

1-4. PLANT DEVELOPMENT.

a. OPTIMUM FACILITY.—Site selection in connection with electronics public works projects must be based on the premise that projects will be engineered to provide the optimum technical facility consistent with inherent logistic and fiscal limitations. As a part of advance planning, a site selection team is formed with representatives of the Industrial Manager and Public Works Officer whose duty is to obtain data upon which engineering decisions are to be based.

Engineering details of site selection are contained in Section 2 of this handbook under specific sub-heads which include antenna siting, transmitting and receiving facilities, link systems and radar.

b. SAFETY.—Safety factors must also be considered in site selection. This applies particularly to sites in proximity to fuel, ammunition and other ordnance material stowage areas. As discussed in United States Navy Safety Precautions, OPNAV 34P1, propagation of radio frequency energy may cause heating of metallic objects or produce spark discharges in the path of propagation. Ammunition and fuel storage spaces are proof against such phenomena if building construction principles are followed which give protection from electrical storms. At those periods when explosives are being handled however, this integrity may be jeopardized, and because most electronic installations are designed for full time operation, danger areas are to be avoided in order to preclude the necessity of "shutting down" during periods of fuel or ammunition handling. Precise information is lacking on what constitutes a "danger area" for electronic installations, but Ordnance Pamphlet 5(OP-5) entitled "Ammunition Ashore" contains quantity—distance tables which specify distance requirements for inhabited buildings, railroads, highways and other magazines for various quantities of ammunition. In general, electronics installations should not encroach on areas of ammunition storage closer than that specified for inhabited buildings. When a question of encroachment arises, resolution of such question is made at departmental level.

c. COMPROMISES.—Some compromise of engineering standards may be required in site selection (such as location, size, obstruction and ground conductivity) due to general area topography, limitations of funds, or logistic factors. Such compromises shall be noted in the site selection report as an engineering decision, citing the justification therefor, or as an evaluation of the engineering concession inherent in restrictions placed on the choice of sites by others. After approval of sites at the departmental level, no compromise of established engineering standards, other than those previously accepted as inherent limitations of the site, shall be included in the Architectural and Engineering planning. Any compromise to the efficient employment of a site, brought about by the planned utilization for other than the prime electronic purpose, shall be referred to the Bureau of Ships for resolution at departmental level.

d. DEVELOPMENT.—The establishment of an electronic facility to meet an operational requirement goes through usual phases of development. These phases are described under "CHRONOLOGY, PUBLIC WORKS PROJECT" with the end result being turnover to management for operation. Once a site has been agreed upon, plans are made under "Architectural and Engineering" planning, development proceeds with ground breaking, construction and installation of facilities.

NOTE

The site selection and development of any electronic facility will be guided by the policies set forth in the following extract from a recent directive concerning communication facilities:

"The Chief of Naval Operations desires to emphasize that the primary and overriding consideration applicable to construction and installation of facilities at Naval Communication activities is that the operational communication facilities shall be sited, arranged and constructed to provide the most effective communications possible within the engineering 'know how' available to the Navy technical bureaus. The siting, arrangement and construction of any other facilities, site improvements or installations shall be subordinated to this requirement. Any compromises contemplated as between an operational communication facility and any other facility at these activities shall be resolved in favor of the communication facility."

1-5. POWER REQUIREMENTS.

Power for the shore station electronic facility is normally obtained from a local commercial power company. On isolated stations, however, provision must be made for power production by whatever method is most practicable. Requirements are based on full load demand plus utilities. In planning Public Works projects or modification of existing facilities, electronic equipment power requirements will be furnished by the Bureau of Ships or Bureau field representative. This enables the construction agency to plan for and provide total power including utility demands. Normal initial provision with allowance for expansion is based on transformers and switching for 150% of full electronic equipment load requirements. Standby and/or emergency power facilities should have a capability of 100% of full electronic load (minimum utilities). Standard practice usually specifies automatic shift emergency power, with gasoline or diesel motor-generators for most electronic equipment, and with provision for fuel reserve storage. This fuel supply should be adequate to permit operation without refueling from sources outside the activity for a period best determined by the field representative of the Management Bureau/Office in collaboration with the construction agency.

Power sources consist of the following:

a. A primary or preferred source of sufficient capacity to provide the peak electric power demand during normal peacetime operations.

b. An alternate or standby source of such capacity that it alone can supply the minimum essential operating electric load of the activity, and, when added to the capacity of the primary source, will provide a combined capacity sufficient to furnish the estimated peak demand under mobilization conditions.

c. An emergency source, usually one or more engine-driven, manual, or automatic starting, emergency generators, of sufficient total capacity to provide the electric power demand for vital operations for which no interruption of power can be accepted.

1-6. BUILDING AND OUTSIDE PLANT REQUIREMENTS.

The Bureau of Yards and Docks has standard plans available for the siting and construction of several building types required to meet the demands of new electronic facilities. These plans include housing for the electronic equipment, utilities and personnel. Technical requirements pertaining to electronic equipment are the responsibility of the Bureau of Ships. These technical requirements, from the electronic standpoint, include the location of buildings, electrical bonding and grounding, construction of antennas and ground systems, specifications for shielded rooms if needed, equipment space requirements, and similar technical criteria designed to insure optimum electronic performance.

1-7. FIRE PROTECTION.

Provision for fire protection is incorporated into all building construction with the following criteria intended primarily for, but not limited to, Transmitter, Receiver, and Terminal Equipment buildings—Communication facilities shall be constructed of fire resistant materials throughout to the extent that carbon dioxide (CO_2) or equivalent will conform to fire protection requirements.

This policy is predicated upon a number of factors which include the following:

a. The great majority of electronic equipment installation and operating areas are manned on a round-the-clock basis, which results in continual supervision of these areas. It follows that prior to the time that the temperature-sensitive heads of a water sprinkler system are affected, a considerable number of CO_2 extinguishers can be brought into action;

b. Almost all the electronic equipment procured by the Bureau of Ships is mounted in individual sheet metal enclosures and/or cabinets, thereby greatly minimizing the amount of combustible material in the immediate vicinity of electronic circuits, and providing considerable isolation for adjacent equipment and furnishings;

c. All electronic equipments are equipped with devices (fuses, circuit breakers, etc.) for protection against possible sources of fire, such as arcing, short circuits, etc.;

d. Operation of water sprinkler systems in extinguishing localized conflagrations may endanger: (1) the operation of serviceable electronic equipment in, or adjacent to the flooded area involved, the continuity of which may be mandatory except under extreme conditions; and (2) operating personnel who must supervise the unaffected (by fire) electronic equipment to insure continuity of operations;

e. Present-day electronics engineering practice, in accordance with the National Electrical Code, calls for the use of communication and power cable sheaths of either non-combustible or flame-resistant material, and for a minimum of inflammable items. It is to be noted that properly engineered electronic equipment installations areas are far less susceptible to fire than office or warehouse storage spaces. Furthermore, it may be assumed that the amount of damage and cas-

ualty resulting from a fire in fire resistive buildings of the type under consideration will be far less than the probable equipment damage created by water sprinkler or fog dispersal systems, not to mention the ever present danger to personnel of electrical shock, and the possibility of total cessation of operations due to water seepage.

1-8. PERSONNEL REQUIREMENTS.

Allowances of personnel to operate and maintain an electronics facility are based on both operational and technical personnel requirements. Because the Bureau of Ships is responsible for the maintenance of electronic equipment, recommendations concerning personnel necessary to perform such maintenance may be solicited of this Bureau. The local Maintenance Authority or other Bureau of Ships representative maintains an engineering staff to render technical assistance to local Public Works offices in the planning and construction of electronics facilities. Engineering assistance in the maintenance of equipment beyond the scope of the station personnel may also be drawn upon from this office.

1-9. PERSONNEL HOUSING AND RECREATION.

The location of barracks, quarters or recreation facilities for personnel takes into consideration technical requirements concerning the functions of the electronic equipment. Housing should be on the outer edge of antenna areas. Due consideration should always be given to the effect on electronic performance. A golf course in the antenna park may have little effect on performance whereas the erection of a tennis court backstop in an antenna field may alter its directivity.

1-10. MILITARY REQUIREMENTS.

An electronic activity is an important link in the defense system of the area in which it is located. It is important therefore that the activity be integrated into the general plan for military defense. This includes defense of the electronic activity itself against attack, and, assurance that the electronic activity can be made available to local military and civilian defense authorities in time of emergency. Thus an air surveillance radar with a normal peacetime function of assisting in air traffic control at a local air base, can become a useful defense weapon when integrated into other local defense activities in time of emergency.

1-11 FISCAL CONSIDERATIONS.

Plant development includes advance planning with consideration of the total cost of an electronic facility . As a rule, the management bureau assumes fiscal responsibility. Total cost for which appropriation of funds will be necessary includes: cost of the land and its development including clearing and construction of roads; buildings for equipment and personnel housing as well as other structures such as water tanks and towers; utilities, including auxiliary power as well as normal; electronic equipment, with provision for its installation and subsequent maintenance. It is the responsibility of the Bureau of Yards and Docks to furnish cost estimates to the sponsor of a public works project. This is accomplished with technical assistance furnished by the Bureau of Ships on the subject of space and power requirements, which also furnishes the sponsor with the cost estimates of the electronic material.

Additional cost considerations are discussed under COMMUNICATION STATION REQUIREMENTS, 1-21, *d.*

1-12. LOGISTIC SUPPORT.

Consideration shall be given to the following to provide assurance of the continued logistic support of an electronic facility when completed: establishment and continuation of an electronics maintenance parts system as well as power and supplies for routine operation of equipment; the quartering and subsistence of personnel; accessibility of supplies and availability of transportation facilities.

1-13. OPERATION AND MAINTENANCE.

The development of an electronics facility involves the selection and initial performance-testing of the electronic equipment by the Bureau of Ships or its representative who also sets up standards and furnishes technical assistance for the equipment installation.

Rules for the operation of electronic equipment installed at a shore activity is the responsibility of the "management bureau or office." As an example, the management control office of a NAVCOMSTA is the Chief of Naval Operations (DNC) and prescribes rules for operation of equipment in its assigned function. Because it is the responsibility of the Bureau of Ships to design and approve the installation of electronics material and to establish policies pertaining to its maintenance, the operation of the electronic equipment shall be in accordance with technical standards as prescribed by the Bureau of Ships. Routine maintenance and repair of equipment is normally accomplished by station personnel with technical assistance provided by the cognizant Maintenance Authority if required. Repairs beyond the capacity of the station personnel are accomplished by the Maintenance Authority or under his direction.

Maintenance of electronic quipment under the technical control of the Bureau of Ships includes provision for the establishment of an allowance, procurement, and stowage of electronic repair parts at Naval Shore Activities. In general, under the present system of procuring electronic equipment, no repair parts are provided with the equipment as maintenance spares. In lieu thereof, "parts peculiar" are procured concurcurently with the basic equipment and stocked in the supply system together with "parts common." Any parts required to maintain the basic equipment must be requisitioned through normal supply channels.

In order to establish a uniform method of procuring, binning, and maintaining stocks of electronic repair parts on the stations, the Bureau of Ships, in conjunction with the Electronics Supply Office, developed a standard system which is similar to the one presently in operation aboard ships. It is based on the identification of all electronic repair parts by standard Federal Stock numbers, the establishment of allowances of repair parts, and the stowing of parts in standard bin and drawer units. It is also based on the inventory of major electronic (including test) equipment on a station. Procedures for the establishment and maintenance of the system are contained in the Electronics Supply Office, "Electronic Repair Parts Allowance List (ERPAL) Processing Guide for the Naval Shore Establishment."

A new concept of Regional Repair Parts Support is being implemented by the Electronics Supply Office. Under this system, insurance type items will normally be positioned at a stocking point which will serve shore activities within a specified geographical area. Exceptions will be made on a case basis for remote or special installations.

Some activities operate under a "shop stores" system. In all cases, however, the adequacy of repair parts support is dependent upon the accuracy of the equipment inventory information provided the Electronics Supply Office by the Activities.

1-14. PHYSICAL SECURITY.

In making provision for physical security of an electronics facility, consideration shall be given to the effects that fences and similar construction may have on the performance of electronic equipment. These effects may include alteration of antenna patterns as well as the generation and conducting of radio interference.

1-15. PLANNING AND CONSTRUCTION.

In order to provide the maximum and most efficient "service to the Fleet," certain electronics facilities are established ashore to meet the "operational requirements" of the Naval Establishment. This results in the ultimate construction of facilities as described in preceding pages, all of which are a part of the "Master Shore Station Development Plan" as prescribed by the Chief of Naval Operations. The planning and construction of these electronic facilities follow prescribed procedures for project development which provide for financing, development, inspection, performance-testing, and maintenance of the facility. The project may fall into one of the following: (1) Public Works Project, as an item of "Military Construction, Navy," (2) Minor Construction, or (3) Special Facilities, depending on the size and scope of the project.

One step in the prescribed procedures for the establishment of an electronics facility is "Architectural and Engineering" planning (A&E). This phase of development occurs after an operational requirement has been firmly established and preliminary to beginning actual construction. A&E development of an electronic facility requires action by the Bureau of Ships which furnishes engineering assistance and exercises technical control in collaboration with the Bureau of Yards and Docks which together, provide or approve plans and specifications for construction of the facility to meet the requirements of the "Management Bureau or Office."

1-16. CHRONOLOGY, PUBLIC WORKS PROJECT, (MILITARY CONSTRUCTION, NAVY).

The following chronology of actions presently required in the development of a Military Construction project is provided for administrative and engineering guidance:

a. The management bureau or office either originates a project at departmental level, or sponsors one that has been submitted by its field activity through the Station and Local Shore Station Development Boards.

b. All projects are submitted by the sponsor according to priorities, to the Shore Station Development Board for consideration.

c. The Chief of Naval Operations (Shore Station Development Board), after approving the project, authorizes the Bureau of Yards and Docks to prepare preliminary engineering studies for presentation to higher authority. The sponsor furnishes the requirements and scope of the project to the Bureau of Yards and Docks and the Bureau of Ships as a basis for planning. The Bureau of Yards and Docks assigns the preliminary engineering task to the cognizant District Public Works Officer. The Bureau of Ships determines space,

equipment, and other technical requirements, and forwards same to the Bureau of Yards and Docks and the local Maintenance Authority. The Maintenance Authority (i.e. Industrial Manager or other Bureau of Ships representative) prepares detailed technical information and installation cost estimates; and provides necessary technical assistance to the District Public Works Officer.

d. The sponsor and the Bureau of Yards and Docks, with the assistance of the Bureau of Ships, prepare the project description, justification, and line item breakdown; and support same at hearings before the Secretary of the Navy, Secretary of Defense, Bureau of the Budget, and Congressional Committees.

Beginning with fiscal year 1960, with few exceptions, the technical collateral electronic equipment and installation funds are included in the annual budget submissions of the sponsor Bureau rather than in the military construction appropriation, and are justified separately.

e. The project is authorized and funded by congressional action. Some large scale projects may be authorized in total but only funded in part. In such cases additional funding increments may be requested in future years to complete the entire scope of the work previously authorized. Request for further appropriations under the authorization are at the option of the sponsor.

In the process of authorizing military construction projects and providing appropriations for their accomplishment, the Congress has repeatedly indicated that funds shall not be used for construction of items other than those shown in the project description or clearly required in connection with the completion thereof.

f. The Bureau of Ships finalizes and forwards site and antenna plans, building single line drawings, and utility requirements to the Bureau of Yards and Docks via the sponsor as firm requirements for A&E development. Copies are sent to the cognizant Maintenance Authority and all interested parties.

g. After Bureau of Yards and Docks selection of an A&E agent, the Maintenance Authority acts as Bureau of Ships representative for electronic engineering control of the A&E development. Preliminary drawings are submitted by the OICC to the sponsor's field representative and to the Maintenance Authority for review and approval. The sponsor's field representative ascertains operational suitability. The Maintenance Authority will review the functional arrangement and capability of fulfilling electronic requirements, indicating approval by signing the drawings as "satisfactory to the Maintenance Authority" from these standpoints. Copies are then forwarded to the Bureau of Yards and Docks by the Officer in Charge of Construction for review by the sponsor and the Bureau of Ships prior to full A&E development.

h. The Maintenance Authority continues electronic engineering control of the A&E development until completion and signs final plans as "satisfactory to the Maintenance Authority" prior to submission to the Bureau of Yards and Docks. Bureau of Ships review is requested by the Bureau of Yards and Docks.

i. The Maintenance Authority acts as consultant to the Officer in Charge of Construction and performs such inspections of construction as deemed necessary by the Maintenance Authority.

j. The Maintenance Authority begins installation planning in time to complete the design and have installation materials on hand when buildings become available. Prior to preparation of the detailed installation plans, four copies of single line drawings, representing the proposed system arrangement to meet operational requirements, shall be forwarded to the Bureau of Ships for bureau and sponsor's approval. The Maintenance Authority shall insure that drawings submitted are satisfactory to the sponsor's field representative.

k. In connection with j (above) the Maintenance Authority shall make known to the Bureau of Ships the estimated cost of the electronic system design and installation work in order that the necessary funds may be approved and allocated. Under military construction projects approved prior to fiscal year 1960, this will be accomplished by a letter request from the Bureau of Ships to the Area or District Public Works Office to reduce the letter pruchase authority amount and issue an allotment to the Maintenance Authority. On other projects, the sponsor Bureau will be requested to provide the funds.

l. When conditions warrant, copies of complete installation plans shall be forwarded to the Bureau of Ships for review prior to initiation of installation. The Bureau will indicate in each case where this is necessary.

m. The Maintenance Authority shall provide a station instruction book plus complete installation plans and test data, as specified in paragraph 1-18, *a.*

n. The Maintenance Authority shall conduct a formal turn-over of the completed installation.

o. Final installation plans and a copy of the station instruction book shall be forwarded to the Bureau of Ships for file and retention.

1-17. IMPROVEMENT PROJECTS (ANNUAL APPROPRIATIONS).

In order to remain within current fiscal limits as prescribed for inclusion in annual appropriations, an improvement project will generally be an alteration to existing facilities. These alteration projects are defined as:

a. Those improvement projects which are associated with a change of major or test equipment allowance and involve public works construction, if at all, only to an extent not requiring inclusion in the military construction budget as a specific project; and,

b. Revision and modernization, on a continuing basis, of electronic portions of standardized plans for advanced base functional components.

These alteration projects may originate with requests or recommendations from shore activities, administrative organizations such as Fleet and Training Commands, the Bureau of Ships and other management bureaus and offices, or the Office of the Chief of Naval Operations.

Equipment may be assigned from the equity of the management bureau or office concerned, and project costs may be paid from the management or technical agency's annual appropriations, in accordance with pertinent instructions.

Procedures for initiation of such a project, and actions required are similar to those prescribed for military construction projects except that they are not reviewed by Shore Station Development Boards and are rarely the subject of consultation with, or action by, the Bureau of Yards and Docks. On the other hand, District Public Works Officers consult and act on such projects with respect to the public works portions.

The following will be added to the end of Section One and will be paragraph 1-22*l*, entitled "Radiation Hazards."

l. Radiation Hazards

(1) General
(2) Explosives
(3) Personnel
  (*a*) Body-Exposure Tolerance
  (*b*) Preventive Measures
(4) Measurement and Instruments.

Technical review may reveal the necessity to transform an alteration project into a new construction project, whereupon the proposal is remanded to the proper point of initiation for reprocessing.

1-18. PRE-TURNOVER REQUIREMENTS.

The actions required in the prosecution of a public works project involving electronics and indication of the general areas in which the Bureau of Ships and its representative have responsibility, have been covered in previous paragraphs. Total action may cover a time spread of three to five years therefore mid-project changes in operational requirements will often necessitate deviation from the precise sequence of action that might have been indicated at first. In view of the turnover of military personnel experienced during such period of time, it is considered essential to document decisions of importance at each step of procedure. Such documentation may consist of conference minutes held by all parties, mutually signed copies of drawings or formal correspondence, and should be in sufficient detail to present a clear picture of the circumstances surrounding each situation. The total record of a project will then constitute a cogent history of its development.

Prior to releasing the electronics installation to the custody and control of the operating command, the installing activity shall have completed the following:

a. Preparation of a station instruction book. The instruction book outline shall conform to the outline as prescribed in Appendix I and shall refer to "as built" installation plans and test data which shall also be provided for the station files. Funds for the preparation of this book are properly charged to electronics design and installation funds. Attention is invited to specifications of Appendix I which indicate an austere publication produced by standard office methods.

b. Execution of a thorough operational check-out of all equipment and systems, and record the test data thus obtained and provide copies for station files.

c. Institution of such familiarization and training programs for station technical personnel as may be dictated by the complexity of the system newly installed.

1-19. TURNOVER PROCEDURE.

A joint inspection and check-off of the completed facility shall be made by the Maintenance Authority or other Bureau of Ships representative, and the Commanding Officer or his representative, covering each of the items as prescribed under "1-18. PRE-TURNOVER REQUIREMENTS." The installing activity shall advise the Commanding Officer, as far in advance as possible, of the projected completion date and request scheduling of the inspection. In cases where a new facility consists of both new and reinstalled equipment, inspection of the new equipment and scheduling of the cut-over portion shall be included in the request. Upon completion of the inspection, the Commanding Officer shall be requested to give written acceptance in one of the following categories:

a. Unconditional: Installation complete and operationally satisfactory.

b. Conditional: Installation operational but not fully satisfactory or complete. The deficiencies responsible for this type acceptance shall be corrected by the installing activity and an unconditional acceptance obtained as soon as possible.

c. Partial: Interim acceptance of a part of the total installation. This category is appropriate where incremental activation of a facility is required by the command in order to maintain the station operations schedule.

1-20. SERVICES PERFORMED BY THE BUREAU OF SHIPS.

The Bureau of Ships may recommend a project pertaining to an electronic activity under the management control of another bureau, or sponsor a project for facilities which are under the management control of the Bureau of Ships. The project may be of such magnitude as to be a Public Works Project, Minor Construction, or Special Facility. In any case, when acting as sponsor, action by the Bureau of Ships is similar to that prescribed for any other sponsor, with technical control of electronic installation retained by the Bureau of Ships.

a. TECHNICAL PLANNING.—In general, the Bureau of Ships technical planning toward fulfillment of an operational requirement consists of the following:

(1) Interpretation of operational requirements based on planned needs for electronic equipment and ancillary items for fulfillment of a mission.

(2) Provision of preliminary arrangement plans, determination of building form factor, and estimation of power required for electronic equipments.

(3) Determination of the number and type of inter-site cables for control purposes and/or link control channels if applicable.

(4) Siting of facilities so as to provide optimum electronic operational environment, consistent with logistic support, and security, as dictated by the mission.

(5) Estimation of total electronic collateral funds required for equipment procurement and installation.

b. PRELIMINARY PLANNING AND FEASIBILITY STUDIES.—In addition to the foregoing, which applies in general to projects which have been formally initiated, the Bureau of Ships shall provide pre-

liminary planning prior to sponsorship, to Management Bureaus and offices, or to the Shore Station Development Boards as required.

This service consists mainly of preliminary site surveys, profile surveys for control link service, noise and interference surveys. Funds for this type of service are provided from Bureau of Ships annual appropriations.

1-21. COMMUNICATION STATION REQUIREMENTS.

The following discussion concerns those components of a Naval Communication Station or Facility (NAVCOMSTA or NAVCOMFAC) consisting of the three facilities, Naval Radio Station (T), Naval Radio Station (R), and Communication Center. At major installations, these components are generally remotely situated with respect to each other and from other activities of the Shore Establishment.

The object of the following specifications is, first, to establish general site and environment criteria in order to permit the choice of a site for a specified electronic facility after the evaluation of the merits of different sites based on the requirements therein, and second, to prescribe the general construction and arrangement requirements from the electronic standpoint.

a. SITE FACTORS.—The principal site factors entering into the optimum choice of the remoted component of a Naval Communication Station or Facility are:

Fundamental suitability of the site for radio communications.

Accessibility of utilities and logistic support.

The total costs of establishing and maintaining the site, its auxiliaries and its operating personnel.

While the proper determination of each of the above factors is generally difficult, these can be resolved by first, determining the scope of the communications and related activities to be provided for; second, by evaluating the site's compliance with certain minimum necessary conditions which must be satisfied in order to permit the desired communications; and third, weighing the relative advantages of each factor with respect to the required minimum values specified. Thus, a nearly perfect site may need to be sacrificed for a moderately good one because the cost of clearing the better site may increase the total cost too greatly over the poorer site. However, in view of the large investment in equipment, facilities and skills of operating personnel required for the purpose of conducting rapid and reliable radio communications, it appears desirable to place particular emphasis on obtaining the better site rather than stressing a site saving that is often a small part of the total cost. It easily can be more expensive to establish good communications on a mediocre site obtained without cost, than on a good site obtained at great expense.

b. FUNDAMENTAL SUITABILITY.—Factors pertinent to the fundamental suitability of a site for the conduct of communications include:

(1) RADIO COMMUNICATING QUALITIES OF THE AREA.—It will be necessary to make some determination of the reception from a number of fixed stations over wide ranges in distance, azimuth, frequency and, when possible, time. Ground wave and skywave transmission should be checked. The results should be compared with similar data from equivalent sites or other sources and a reasonable estimate made of propagation capabilities.

(2) GROUND CONDUCTIVITY AND UNIFORMITY.—It will be necessary to determine the character and homogeneity of the soil at the site. A highly conducting and uniform soil, extensive in depth and area, approaches the ideal ground plane for most types of antennas in present day use at Naval shore radio stations. Soil subject to glacial movement, erosion, seasonal or other variations should be avoided. The soil conductivity should be not less than 5×14^{-14} emu.

(3) TERRAIN.—The terrain of the site should be reasonably flat or rolling with no abrupt rises or descents. Because of the extreme importance of low angle propagation and reception for long distance communications, no obstacle should extend more than 5 degrees above the horizon when viewed from any point in the antenna field.

(4) WEATHER.—If great dissimilarity of weather conditions exists at prospective sites, it should be given consideration provided other factors are nearly equal. Construction and maintenance expenses may be reduced thereby.

c. ACCESSIBILITY.

(1) UTILITIES.—It will be necessary to conduct a survey of the relative accessibility of transportation, electrical power, telephones, water, sewerage and other facilities. (The availability of commercial utilities should not reduce the requirements for adequate secondary, i.e. emergency, utilities.)

(2) LOGISTIC SUPPORT.—It will be necessary to survey the requirements for logistic support of proposed station and to relate these requirements to the capacity of Naval or other available logistic establishments in the vicinity.

(3) DEFENSE.—The site should be so located that its defense against attack can be integrated with the general defense of the area.

(4) RECREATION.—Whenever possible the site should be located within reasonable distance of a pop-

ulation center of sufficient size to provide recreation for station personnel. Where this cannot be afforded, planning should include the provision of adequate recreational facilities for the maintenance of morale.

(5) LINK FACILITIES.—Because of the necessity of interconnecting land lines or link circuits between component facilities, the location of one component with respect to the others should be seriously considered. Where microwave links are required, planning so that repeater stations are not required will greatly reduce original cost and upkeep of the station.

d. COSTS.—The total cost of constructing, operating, and maintaining a facility will include:

(1) REAL ESTATE COST.—Because radio stations are generally located in sparsely settled areas, land acquisition will probably be a minor factor in the over-all cost of the facility. Nevertheless, consideration should be given to the possibility of locating the facility on government-owned land, if possible. Due precautions should be taken at the time of transfer, purchase, or lease, to provide not only sufficient area to accommodate the calculated reasonable expansion such as might be occasioned by the declaration of a national emergency, but also to establish by legal means a restricted zone surrounding the site which will effectively prevent later encroachment by habitable or industrial developments. It has been well demonstrated that this procedure is far more economical than the relocation of a station, occasioned by an intolerable industrial encirclement with its attendant overshadowing building construction, and a resultant lowering of the station's communication efficiency.

(2) CONSTRUCTION COST.—Other things being equal, the cost of constructing a facility may be minimized through a judicious choice of site. A site with poor foundation conditions should be avoided. If sites are inaccessible or remotely located from adequate labor markets, construction costs will soar. The cost of bringing roads, water, power, sewer, and other utilities to the area is a considerable item of expense and varies widely according to the site chosen. Sites which are ideal from an operational standpoint may, in some instances, be very costly from a construction standpoint. Although operational requirements may not be jeopardized because of cost considerations, a proper balance is generally achieved through compromise between the bureaus concerned.

(3) MAINTENANCE COSTS. — The cost of maintaining a facility is to a considerable extent dependent on the adequacy of the original planning and construction. There is sometimes a tendency to sacrifice permanency of construction in order to meet budget limitations or forestall construction overruns. Such practice should be avoided whenever possible, and when necessary, should be undertaken only with full knowledge of the increased maintenance costs that may result. Surplus prefab buildings and quonset huts that often may be obtained without cost to the using activity will increase maintenance expense far out of proportion to the few dollars saved on the initial investment. They should not be considered as a substitute for the permanent type facilities required at an established station.

(4) OPERATING COSTS.—Site considerations should include the ultimate costs of operation. Such costs include power, leased wire service, transportation, maintenance of a security patrol, if required, and other items which contribute to total operating costs; and which may vary for different sites.

(5) SUMMARY.—Cost estimates should include:

(*a*) Site cost, including restricted zone and necessary improvements such as clearing, grading, etc.

(*b*) Road cost.

(*c*) Construction cost of operating building, barracks, quarters, sentry house, garage, power house, recreation building, and other recreation facilities as necessary; antennas, towers if required, landscaping, fire protection, water supply, emergency power supply, transportation (trucks, buses, etc.), sewage disposal, maintenance machinery (lawn mowers, graders, etc.) and supplies (paint, ladders, etc.); fuel storage, heating, air-conditioning, paving, fences, etc.

(*d*) Annual total maintenance cost of station, established in accordance with this specification.

(*e*) Total personnel requirements.

(*f*) Cost estimates should be prepared for each prospective site and these estimates compared. The primary decision, of course, should be based on the fundamental suitability of the site for radio communications. This decision should be modified only when the minimum disparity in fundamental suitability and maximum disparity in total cost exist. The limit of tolerable disparity is entirely relative to the individual case and therefore indefinable.

e. EXPANSION AND EMERGENCIES.—Adaptability of the arrangement and construction to meeting normal expansion requirements and emergencies includes:

(1) EXPANSION.—A prime requisite of the ability to expand is space. Expansion at the Naval Shore Radio Station involves additional communications equipment, antennas, housing, subsistence of personnel, and demands on utilities. Considerable space can be provided for use in expansion if the need for it is kept in mind during the planning stage.

(*a*) Additional communication equipment will require additional operating space. Therefore, plans for the operating building should contain provisions for adding to the building without undue disruption of existing installations.

(*b*) Space for additional antennas can be provided by employing a rosette plan of installation. Rosettes should be located around the operating building in a manner similar to that shown on Bureau of Ships Drawings RE 6F 2205. Diversity reception can be effected by proper use of antennas at a receiver station.

(*c*) Quarters areas should be concentrated on a boundary of the station to obtain maximum antenna area. However, planning should provide space for expansion of the quarters without undue invasion of the antenna area.

(*d*) Adequate utilities should be assured in the planning stage and sufficient allowances made for the requirements upon expansion.

(*e*) Construction should employ standard Navy stock or material which will meet the requirements of Navy specifications. The use of non-standard components which may be difficult to replace or duplicate should be avoided. Methods of construction should follow conventional practice and should employ standard procedures. This will facilitate rapid expansion when it becomes necessary.

(2) EMERGENCIES.—A Naval shore radio station should be capable of continued self-sustained operation for a considerable length of time. To this end every facility, vital to the station's continued operation, should be provided with an emergency supply.

(*a*) EMERGENCY POWER SUPPLY. — An emergency power supply capable of handling the load of the station should be provided. An automatic, quick start, change over system should be supplied.

(*b*) EMERGENCY WATER SUPPLY. — Where it is found feasible to use a commercial source of water supply, adequate storage facilities to provide sufficient water for fire protection and continued self sustenance; or a well on the station with the automatic pumps, should be provided.

(*c*) TRANSPORTATION. — Sufficient transportation equipment and shelter to insure continued operation of the station in event of failure of normal methods should be provided.

(*d*) FIRE PROTECTION. — Adequate fire fighting facilities for controlling all types of fire, e.g., brush fires, fuel supply, buildings, electrical fires, etc., should be provided on the station. Automatic sprinkler systems within equipment spaces are not authorized.

(*e*) SUBSISTENCE.—Adequate storage facilities should be provided in order to subsist the station during emergency periods.

1-22. SPECIAL REQUIREMENTS.

a. THE RADIO TRANSMITTER STATION.—In addition to the general requirements pertaining to site selection and environmental factors which are described in paragraph 1-21, the principal factors entering into the general arrangement and construction of a Naval Shore Radio Transmitting Station are:

Fundamental suitability of the arrangement and construction for the conduct of efficient communications;

The adaptability of the arrangement and construction to meeting normal expansion requirements and emergencies;

The total cost of constructing and arranging the station.

The proper determination of each of the above factors is *not* generally difficult and can be resolved by first, determining the scope of transmission to be conducted; second, by evaluating the compliance of the construction and arrangement with certain minimum necessary conditions which must be satisfied in order to permit the desired transmission; and third, weighing the relative advantages of each factor with respect to the required minimum specified.

(1) PRIMARY OBJECTIVE.—There should be little choice in the matter of cost of construction of a Naval radio transmitting station if the primary reason for construction is kept in mind. The station should be constructed to *transmit radio signals.* The choice concerning cost of construction when a choice is allowed, should be considered on the basis of unit cost per efficient transmitting circuit. It is false economy to sacrifice transmitting efficiency to economic expediency.

(2) SUITABILITY FOR COMMUNICATIONS. —Factors pertinent to the fundamental suitability for the conduct of efficient communications include arrangement and construction to permit maximum flexibility in the utilization of transmitters and antennas, and to eliminate noise and interference.

(*a*) The operating building or the terminal point of the transmission lines should be located as near the center of the station as terrain will allow. This will provide the maximum antenna area and reduce the length of the required transmission lines.

(*b*) All buildings, except the operating building, should be concentrated near the station boundary, in order to allow the greatest antenna area, and to permit maximum control of noise and interference on the station.

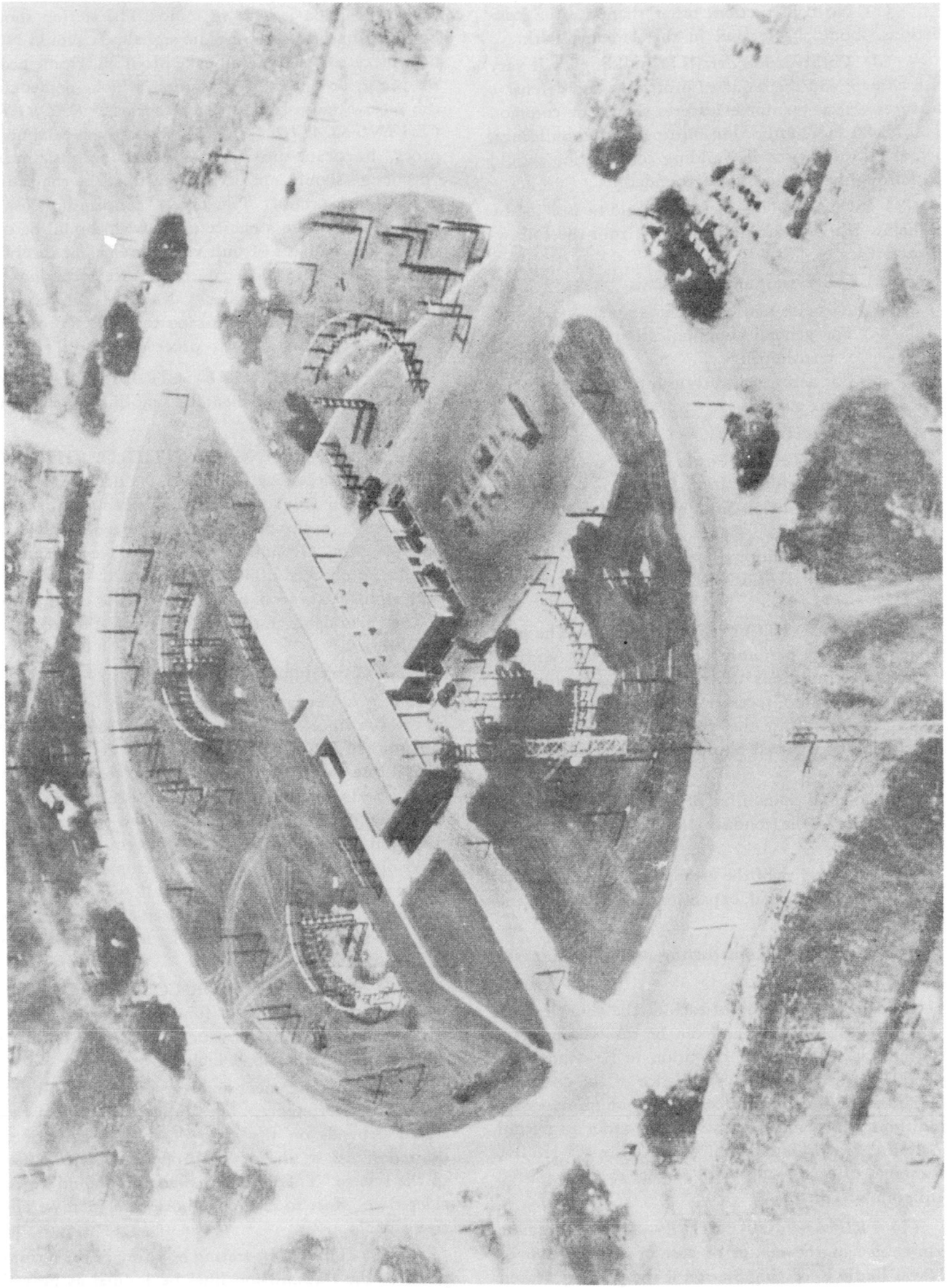


Figure 1-2. Radio Transmitter Building

(*c*) No construction, other than utilities connections, should be located in the Antenna Park.

(*d*) Construction details of buildings will vary with climate and the required protective and defensive measures. However, some features should be common to all Naval shore radio transmitting station buildings, such as all metal used in building construction should be thoroughly bonded and grounded.

(3) ISOLATION.—The site should be isolated by the below listed minimum distances from the following activities.

(*a*) Other transmitter stations ..... 3 miles

(*b*) Airfields and glide paths:
For general communication transmitting ..... 3 miles
For aeronautical transmitting at air stations ..... 1500 feet

(*c*) Main Highways ..... 1000 feet

(*d*) High Tension Power Lines (overhead):
Transmitter station feeders ..... 1000 feet
Transmission lines and transformer stations ..... 1 mile
(For additional criteria on isolation, see THE RADIO RECEIVER STATION, *b* (4).

b. THE RADIO RECEIVER STATION.—The general requirements pertaining to site selection and environmental conditions described in paragraph 1-21 apply to the radio receiver station. The principal factors entering into the general arrangement and construction of a Naval Shore Radio Receiver Station are:

Fundamental suitability of the arrangement and construction for the conduct of efficient communications;

The adaptability of the arrangement and construction to meeting normal expansion requirements and emergencies;

The total cost of constructing and arranging the station.

The proper determination of each of the above factors is *not* generally difficult and can be resolved by first, determining the scope of reception to be conducted; second, by evaluating the compliance of the construction and arrangement with certain minimum necessary conditions which must be satisfied in order to permit the desired reception; and third, weighing the relative advantages of each factor with respect to the required minimum specified.

(1) PRIMARY OBJECTIVE.—There should be little choice in the matter of cost of construction of a Naval Radio Receiving Station if the primary reason for construction is kept in mind. The station should be constructed to receive radio signals. It should NOT be constructed as an earthquake proof, hurricane proof, rat proof, or bomb proof station which incidentally, can receive radio signals but rather as *A RADIO RECEIVING STATION* which incidentally, is earthquake proof, hurricane proof, et al. The enthusiasm for "proofing" should not be allowed to make the station also "signal proof." The choice concerning cost of construction, when a choice is allowed, should be considered on the basis of unit cost per efficient receiving circuit. It is false economy to sacrifice receiving efficiency to economic expediency, since reduced receiving efficiency requires transmitter power to be inordinately increased which is a costly proceeding.

(2) FUNDAMENTAL SUITABILITY.—Factors pertinent to the fundamental suitability of a site for radio reception include:

(*a*) RECEIVING QUALITIES OF THE AREA.—It will be necessary to make some determination of the reception from a number of fixed stations over wide ranges in distance, azimuth, frequency and, when possible, time. Ground wave and skywave transmission should be checked. The results should be compared with similar data from equivalent sites or other sources and a reasonable estimate made of the reception capabilities.

(*b*) NOISE LEVEL AT THE SITE.—It will be necessary to determine the undesirable noise peculiar to the site since the ability to communicate is a direct function of the signal-to-noise ratio at the receiver. The noise level (man-made interference and not atmospheric or random galactic disturbances) of a desirable site should not exceed two microvolts per meter in the 10 KC to 140 MC frequency range as determined by standard Navy instrumentation. This figure is the absolute maximum allowable at the undeveloped site and only in extremely rare instances can it be expected to diminish. Rather, an increase is almost a certainty.

(3) SUITABILITY FOR COMMUNICATIONS.—Factors pertinent to the fundamental suitability of the arrangement and construction for the conduct of efficient communications include:

(*a*) Arrangement and construction to eliminate noise and interference. The ability to receive a radio signal depends on the ratio of the strength of the desired signal to the strength of the undesired noise in the system. Therefore, all planning should be considered an effort to minimize noise and increase effective signals.

(*b*) That the operating building or the terminal point of the transmission lines be located as near the

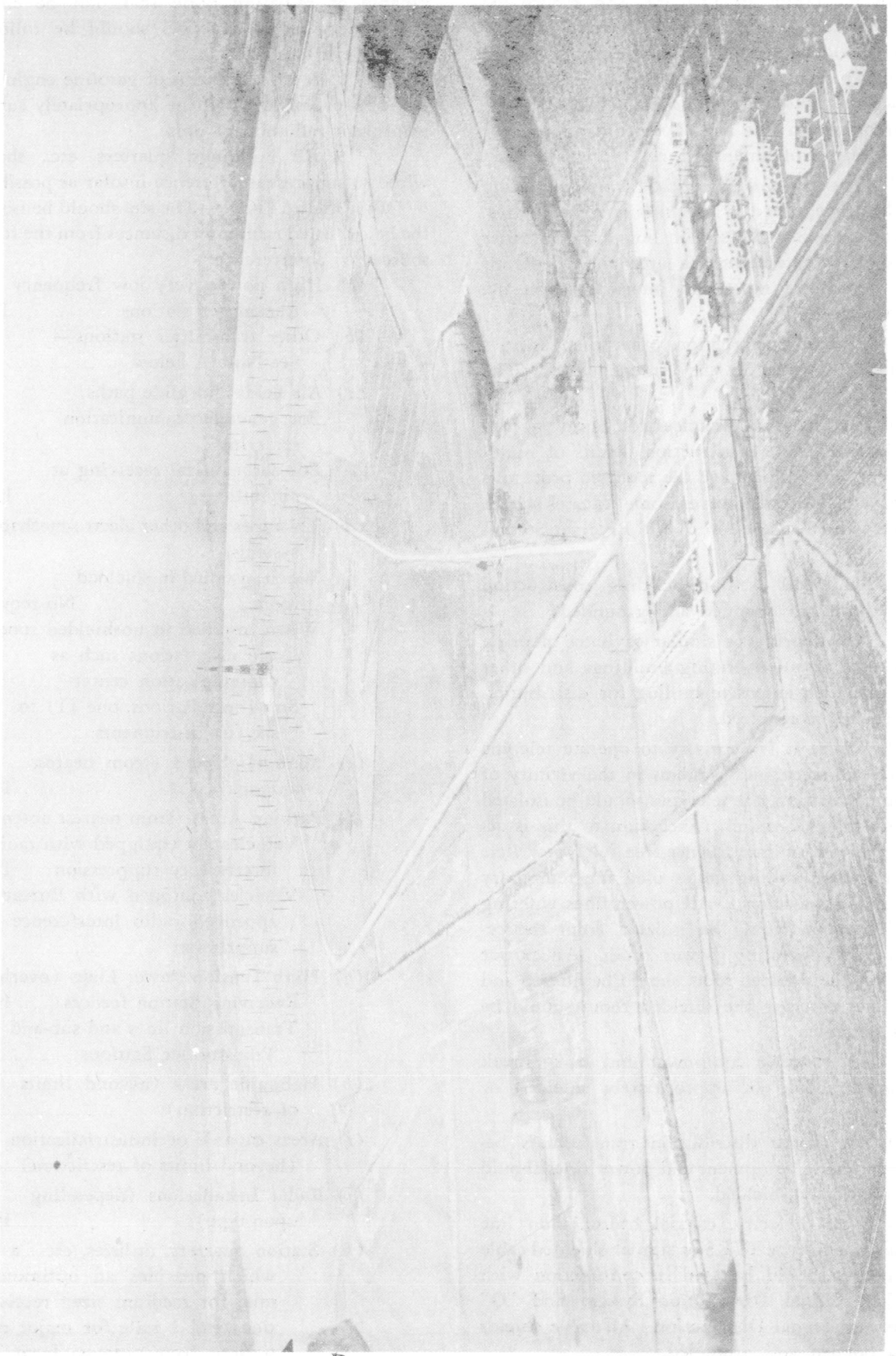


Figure 1-3. Radio Receiver Station

center of the station as terrain will allow. This will provide the maximum antenna area and reduce the lengths of the required transmission lines. Transmission lines should be 70 ohm, solid dielectric, coaxial cable, properly terminated, which can be buried and thus reduce the noise pickup usually effected by an exposed transmission line and thus reducing cost for lease and clearing of antenna park.

(*c*) That all buildings, except the operating building, be concentrated in an administration, service, and housing area near the station boundary, in order to provide the greatest antenna area and to permit maximum control of noise and interference on the station. See figure 1-3.

(*d*) That no construction, other than utilities connections, be located in the Antenna Park. The utilities should be buried.

(*e*) That standard practices for building construction be followed. Construction details of buildings will vary with climate and the required protective and defensive measures. However, some features should be common to all Naval Shore Radio Receiver Station buildings:

1. All metal used in building construction should be thoroughly bonded and grounded.

2. "Q" flooring or similar cavitated flooring should be used in all operating buildings and other buildings in which extensive cabling for distribution of signal energy is required.

3. Where it is necessary to operate teletype or other electro-mechanical systems in the vicinity of a receiving installation, the teletypes should be isolated in a double shielded room. (Exception to this is accepted in the case of interference-free teletypewriters mounted on small rolling tables used for temporary monitoring and servicing.) All power lines entering the shielded room should be isolated from the remainder of the operating power room. All power lines entering the shielded room should be filtered and all other lines entering the shielded room should be filtered if possible.

4. All rotating equipment and make/break cycle contacts should be appropriately shielded or isolated.

5. All power distribution transformers between the receiving equipment and power lines should be electro-statically shielded.

6. Solid dielectric coaxial transmission line for RF energy, and type TTRS or similar shielded cable for AF energy, should be used in conjunction with the Standard Signal Distribution System and "Q" flooring for all Signal Distribution. All cable shields should be bonded and grounded.

7. Fluorescent lighting or other lighting capable of radiating noise shall not be employed. Good illumination practices should be followed to prevent eye fatigue.

8. Ignition systems of gasoline engines, automatic furnaces, etc., shall be appropriately suppressed to prevent radiation of noise.

9. All buildings, quarters, etc., should be wired to suppress interference insofar as possible.

(4) ISOLATION.—The site should be isolated by the below listed minimum distances from the following sources of interference:

(*a*) High power, very low frequency transmitter stations ..... 25 miles

(*b*) Other transmitter stations—
See Note A below ..... 5 miles

(*c*) Air fields and glide paths:
For general communication receiving ..... 5 miles
For aeronautical receiving at air stations ..... 1500 feet

(*d*) Teletypes and other electro-mechanical systems:
When installed in shielded room ..... No requirement
When installed in unshielded room
Large installations such as communication center ..... 2 miles
Small installations, one (1) to six (6) instruments ..... 200 feet

(*e*) Main Highways (from nearest antenna) ..... 1000 feet

(*f*) Parking Areas (from nearest antenna):
Vehicles not equipped with radio interference suppression ..... 1000 feet
Vehicles equipped with Bureau approved radio interference suppression ..... 25 feet

(*g*) High Tension Power Lines (overhead):
Receiving Station feeders ..... 1000 feet
Transmission lines and sub-and Transformer Stations ..... 1 mile

(*h*) Habitable areas (beyond limits of restriction) ..... 1 mile

(*i*) Areas capable of industrialization (beyond limits of restriction) ..... 1 mile

(*j*) Radar Installations (depending upon type) ..... 1500 feet

(*k*) Station quarters, utilities, etc. ..... a corridor which provides an optimum of ½ mile for medium sized receiving stations and 1 mile for major receiving stations from antenna farm.

NOTE A

Clearances from local transmitters should be viewed from a realistic viewpoint as rigid interpretation of specifications would unnecessarily hamper receiver site selection. Certain transmitters such as links and emergency communications must be tolerated on the receiving station. An overmodulated amateur transmitter on a housing development close to the radio reservation can cause more interference than a 50 KW transmitter several miles away, while a foreign non-regulated, overmodulated broadcast transmitter just across the border can completely jeopardize the operations of a nearby receiving station by spurious radiations over a wide band. In evaluating the amount of interference to be anticipated, the effective transmitter power (beamed antenna, etc.), type and efficiency of emission, frequencies, etc. should be considered. These estimates must be confirmed by actual field measurements before a final decision on the site is reached.

As regards non-Navy transmitting stations, the limitations desired by the Bureau of Ships are as follows:

1. Five (5) miles distance between Navy Radio Receiving Station and non-Navy transmitting stations, or,
2. The signal level from the non-Navy station shall not exceed ten (10) millivolts per meter (field intensity) at the boundary of the Navy site, and
3. No harmonic or spurious radiation from the non-Navy station to exceed five (5) microvolts per meter (field intensity) at the boundary of the Navy site.

While realistic consideration must be given existing st..ions, a relaxation of the above limitations will be reflected in a reduced operating efficiency of the Navy station concerned.

c. THE COMMUNICATION CENTER.—The Communication Center together with the radio transmitting station and radio receiver station form the three major components of a Naval Communication Station or Naval Communication Facility. The Communication Center is the agency responsible for the receipt, transmission, and delivery of messages.

(1) COMPONENTS.

MESSAGE CENTER.—The message center is responsible for the acceptance, preparation for transmission, receipt, and delivery of messages.

RELAY STATION OR AUTOMATIC SWITCHING CENTER.—The function of the relay station or automatic switching center is to relay messages with semiautomatic or automatic teletypewriter equipment.

CONTROL LINK.—Control link equipment may be required for keying transmitters from the communication center and to provide a receiving terminal.

CRYPTOGRAPHIC CENTER. — The cryptographic center enciphers, deciphers, accepts, and delivers classified traffic.

OTHER ACTIVITIES. — The communication center may include other activities such as a Communication Security Activity, wire and telephone rooms, a radio-photo unit, and a remote visual signal station, along with necessary facilities for operations, administration, utility, maintenance, and personnel.

(2) SITE.—The location of the Communication Center will depend on local requirements and requirements established by the Chief of Naval Operations (DNC). It is no longer considered essential that the Center be located convenient to the command headquarters since the functions of the Center are largely of a relay nature. Instead, the command is provided a message center of sufficient size only to handle traffic destined for and originated by it. From an economic standpoint it is usually necessary to locate the center on an existing Naval reservation. If a more favorable site is not available and the center must be located at a receiver station, the choice of a site must be carefully made to avoid degradation of the primary mission of the receiver station itself. It is incumbent on the technical personnel to make a careful study and offer recommendations toward this end.

In any case, communication centers and terminal equipment buildings should be separated a minimum of one mile from primary radio receiving facilities because communication center/terminal equipment buildings contain equipment (such as teletypewriters) that may generate radio interference difficult to suppress or control. Because these facilities contain communication control link equipment, including receivers and transmitters operating at ultra-high or super-high radio frequencies, site characteristics applicable to receiver buildings also may apply to communication centers and terminal equipment buildings.

If practicable, the site should be selected for direct line of sight between the communication center and the transmitter and receiver stations, using towers for link paths on a horizontal plane free of obstructions for a distance of 100 feet on either side of the center line. If repeaters are necessary because of unfavorable

terrain, repeater sites should provide the required path, with a minimum of antenna heights.

In new construction, consideration must also be given to site selection and building construction which will permit erection of casualty and other antennas as required.

(3) QUALIFYING FACTORS — Principal factors in selecting a site for a communication center and a terminal building will include:

(*a*) Suitability of the site as a Communications Center, technically and strategically.

(*b*) Accessibility to utilities and logistic support.

(*c*) Cost of establishing and maintaining the site, its auxiliaries, and operating personnel; with cost estimates based along general lines as discussed under COMMUNICATION STATION REQUIREMENTS, 1-21,*d*.

(4) GENERAL BUILDING REQUIREMENTS. —Permanent buildings for communication centers are usually of masonry and/or reinforced concrete construction. Interior partitions (except those enclosing stairwells, toilets, vaults, elevator hoistways, and machinery rooms in basements) should be metal or wood studs and plaster or dry wall construction for easy rearrangement of operating spaces and free from all electrical and heat controls. Exterior walls (except doors and openings necessary for ventilation and air-conditioning systems) are unpierced by windows. This type of construction provides proper security without special scatter-proof or bombproof design.

In planning new construction, the subject of vault vs. safe storage requires consideration. Safe storage provides greater flexibility but vaults may be more suitable for certain applications. Local requirements will determine which storage facility is most suitable.

Communication Centers are designed for ready access to main distribution frame room, multicouplers, raceways for wiring, cable trenches, and wiring passageways. This may be done with cellular steel floors (where floors do not rest directly on the ground), trenches, and overhead wiring racks or ladders. The building is wired to suppress radio interference by providing space inside the outlet boxes for capacitor-resistor network filters. The building should also have the required loading platforms and an elevator if it is higher than one story.

Adequate fire fighting facilities for controlling all types of fire should be provided, but automatic sprinkler systems within equipment spaces are not authorized.

d. NAVAL AIR STATION RADIO FACILITIES. —The following specific requirements are desirable minimum standards. It is realized that in certain cases compromises will be necessary because of limited usable land areas or similar contingencies. However, these requirements shall be adhered to wherever possible and all budgetary estimating for new construction projects shall be based on these standards. Figure 1-4 shows the typical communication facility arrangement with the desirable separation of components as indicated.

(1) GENERAL REQUIREMENTS.

(*a*) GENERAL.—Except as herein modified, the specifications for site selection for The Radio Transmitting Station and The Receiver Station as described in paragraphs 1-21, *a*. 1-22, *a*. and 1-22, *b*. apply. Site selection criteria for all electronic facilities are based on technical requirements pertaining to the generation of mutual interference and maximum utility. The specified minimum separations therefore will be maintained insofar as possible.

(*b*) AIRCRAFT CLEARANCE.—Sites shall be in conformance with Bureau of Aeronautics' requirements for aircraft clearance and should be so located as to anticipate possible expansion of the runway system without relocation of communication facilities. The Bureau of Aeronautics publication "PLANNING STANDARDS FOR NAVAL AIR STATIONS" shall be used as a guide. This publication is promulgated under BuAer Inst. 11012.1 of 9 December 1952.

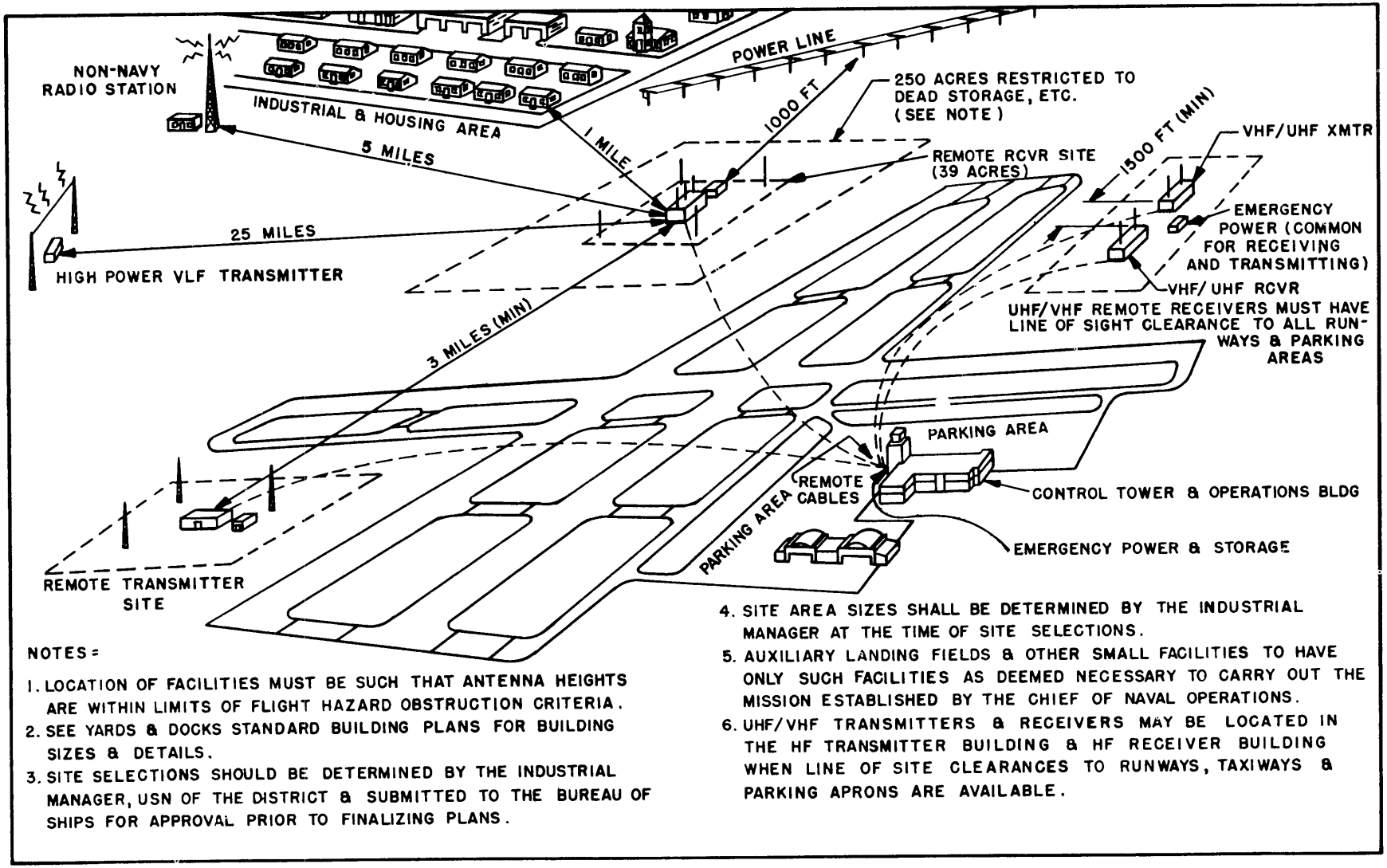
(*c*) AMMUNITION AND FUEL STORAGE AREAS.—If the radio facilities requirements that follow as listed in paragraphs (2) (*c*) through (*f*) inclusive, can be met in these areas, there is no technical objection to locating the same in ammunition and fuel storage areas. Any decision to so locate shall take cognizance of the risks involved and require full approval of the appropriate technical bureaus and cognizant commands. If waiver requirement exists, it should be initiated at activity level in accordance with established procedures.

(*d*) LIVING QUARTERS.—Living and messing facilities, other than emergency bunking, shall not be incorporated in any building normally designed for exclusive employment for communications.

(*e*) EMERGENCY POWER.—Automatic start emergency generators with manual features (provided if automatic features fail), are required at each site, housed in space not an integral part of the main structures.

(2) SPECIFIC REQUIREMENTS.

(*a*) OPERATIONS BUILDING. — The standard operations building, shown in figure 1-5, provides facilities for four major functions: (a) operations, (b) communications, (c) aerology, and (d) air traffic



NOTES:

1. LOCATION OF FACILITIES MUST BE SUCH THAT ANTENNA HEIGHTS ARE WITHIN LIMITS OF FLIGHT HAZARD OBSTRUCTION CRITERIA.
2. SEE YARDS & DOCKS STANDARD BUILDING PLANS FOR BUILDING SIZES & DETAILS.
3. SITE SELECTIONS SHOULD BE DETERMINED BY THE INDUSTRIAL MANAGER, USN OF THE DISTRICT & SUBMITTED TO THE BUREAU OF SHIPS FOR APPROVAL PRIOR TO FINALIZING PLANS.
4. SITE AREA SIZES SHALL BE DETERMINED BY THE INDUSTRIAL MANAGER AT THE TIME OF SITE SELECTIONS.
5. AUXILIARY LANDING FIELDS & OTHER SMALL FACILITIES TO HAVE ONLY SUCH FACILITIES AS DEEMED NECESSARY TO CARRY OUT THE MISSION ESTABLISHED BY THE CHIEF OF NAVAL OPERATIONS.
6. UHF/VHF TRANSMITTERS & RECEIVERS MAY BE LOCATED IN THE HF TRANSMITTER BUILDING & HF RECEIVER BUILDING WHEN LINE OF SITE CLEARANCES TO RUNWAYS, TAXIWAYS & PARKING APRONS ARE AVAILABLE.

Figure 1-4. Radio Communication Faciliti s, Naval Air Station

control. At activities to which Fleet Air Wing staffs are assigned, additional space for these staffs must be provided. A standard structure has been developed that is flexible in plan and can be expanded for possible growth of operating facilities. A complete breakdown of the area of the operations building and control tower according to the five increments is shown on figure 1-5.

The location should be along the apron line (set back from the pavement edge a minimum of 100 feet) near the apex of the runway configuration to obtain maximum visibility for the control tower operations, and must conform to the safety clearance standards for airfields. An unobstructed view of all runway approaches, runways, and other operational areas where airfield traffic is controlled must be maintained. Consideration must be given to possible runway extensions and the planning of future line facilities. In this respect, any proposed hangar must be located so that it does not obstruct the line of sight from the control tower cab. It may be necessary at certain existing airfields to erect a free standing control tower, as shown in figure 1-6 to obtain the desired visibility, or to build the control tower in conjunction with a hangar or other high structure to obtain the required line of sight to all aircraft operating areas.

As shown in figure 1-5, space is provided for the following Communication Department facilities:

1. Communications office.
2. Operations radio and cipher and teletype equipment.
3. Frame Room.
4. Electronics repair shop.
5. Air traffic control equipment.
6. Radar transmitters and problem room.
7. Observation platform.
8. Officers' bunkroom.
9. Enlisted men's bunkroom.
10. Space for the Fleet Air Wing provided if necessary, consideration being given to the integration of Fleet and operations radio facilities.

(*b*) CONTROL TOWER. — Arrangement to provide adequate space for the location of a standard operator's control console, VHF/UHF direction finder equipment, and emergency VHF/UHF communication equipment. Suitable foundations and supports to be provided on the tower roof for the VHF/UHF antennas, clear of obstructions. Adequate cable raceways to be provided for all equipment locations.

Where control tower electronic communication equipment is to be installed in the tower structure proper, in, or adjacent to which is to be installed an automatic-start emergency generator, no need for battery-operated standby equipment exists.

Where electronic communication equipment is installed in remote facilities, even though these facilities are equipped with automatic-start emergency generators, standby equipment shall be installed in the tower area. Sufficient equipment shall be installed to provide simultaneous transmission or reception on the following Navy tower channels: (1) UHF primary, (2) UHF emergency, (3) VHF primary, (4) VHF secondary. Standard a-c operated equipment such as the TED - AN/URR-13 and AN/URT-7 - AN/FRR-27, or the preferred allowance type for the applicable services, shall be provided and connected to permit selected operation from either the normal or emergency power source. Control of this emergency communication equipment shall be independent of normal console control facilities.

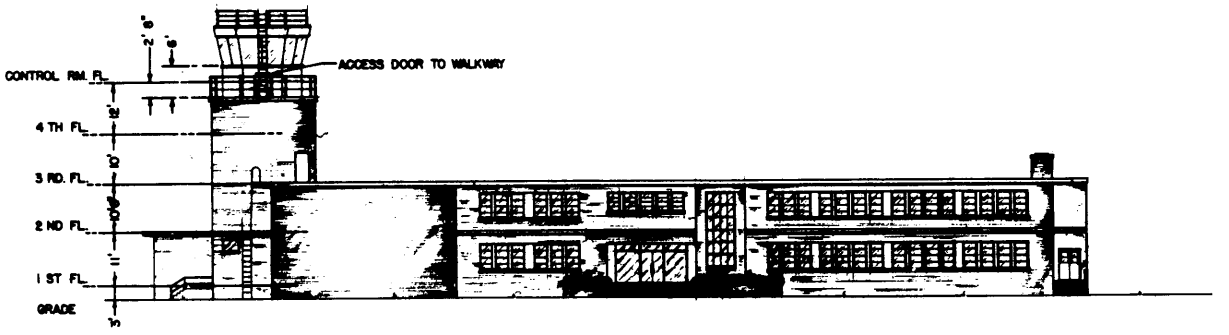
The control tower in figure 1-6 is normally five stories high and may or may not be a part of the operations building. In relatively flat terrain, a height of 40 feet from the ground to the floor of the control room is considered the minimum acceptable elevation. The tower structure must provide for:

1. Emergency generator equipment.
2. Air-conditioning equipment.
3. Instrument control room (electronic equipment room).
4. Electronic equipment.
5. Toilet facilities.
6. Control room (or control cab).

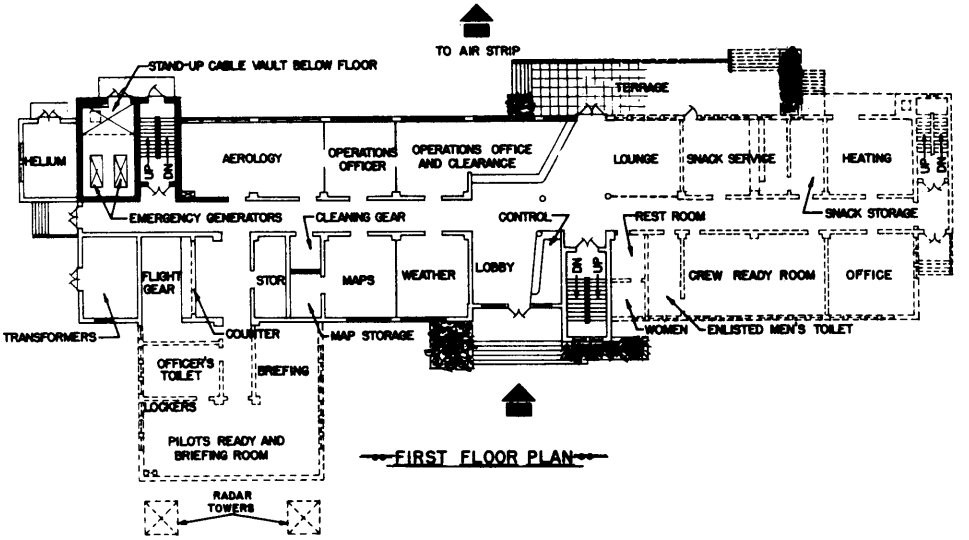
(*c*) HIGH FREQUENCY TRANSMITTERS— To be located a minimum of three miles from the air station high frequency receiver site, one mile from the operations building and control tower, 1500 feet from VHF/UHF receiving building, and where it can be protected from obstructions (maximum permissible five degrees) resulting from growth of the air station.

In general, antennas will be recently developed sleeve antennas (Bureau of Ships Drawing RE 66F 2073, 8 sheets) with heights up to 115 feet, and cut and wide-band doublet antennas with heights up to 80 feet. When a high-power low-frequency homer is to be installed, a 150-foot vertical radiator-type antenna may be required.

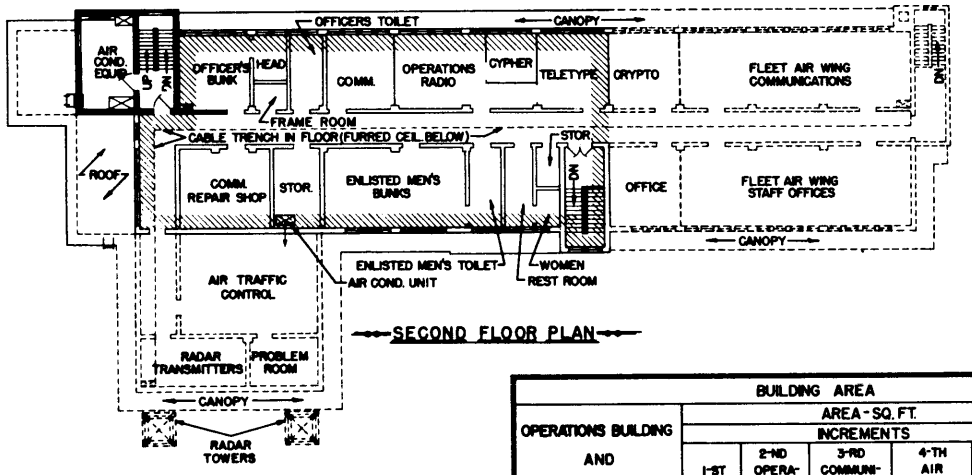
The site should consist of a relatively flat square area of 60 acres, with the transmitter building centrally located and surrounded by its field. This acreage allows for 25 percent future expansion of the antenna field. Whenever possible, the site should have line of sight to the runway system so that VHF/UHF



FRONT ELEVATION



FIRST FLOOR PLAN



SECOND FLOOR PLAN

GENERAL NOTES:

1. SCHEME "A" SHOWS CONTROL TOWER AT RIGHT END OF OPERATIONS BUILDING. FOR DETAIL WORKING DRAWINGS, SEE Y. & D. DRAWINGS 562520 & 562565.
2. SCHEME "B" SHOWS CONTROL TOWER AT LEFT END OF OPERATIONS BUILDING. FOR DETAIL WORKING DRAWINGS, SEE Y. & D. DRAWINGS 565286 & 565331.

OPERATIONS BUILDING AND CONTROL TOWER	BUILDING AREA — AREA-SQ. FT. INCREMENTS					
	1-ST TOWER	2-ND OPERATIONS OFFICE	3-RD COMMUNICATIONS	4-TH AIR TRAFFIC CONTROL	5-TH FLEET AIR WING	TOTALS
BASEMENT--CABLE RM.	118	-	-	-	-	118
HEATER ROOM	204	-	-	-	-	204
1-ST FLOOR-MAIN BLDG.	441	4,785	-	1,322	2,850	9,398
1-ST FLOOR-HELIUM RM.	-	204	-	-	-	204
1-ST FLOOR-ENTRANCE	-	131	-	-	-	131
2ND FLOOR	441	-	4,217	1,322	2,850	8,830
3RD FLOOR	441	-	-	-	-	441
4TH FLOOR	441	-	-	-	-	441
5TH FLOOR-CONTR. CAB	441	-	-	-	-	441
TOTALS	2527	5,120	4,217	2,644	5,700	20,208

Figure 1-5. Standard Air Station Op rations Building

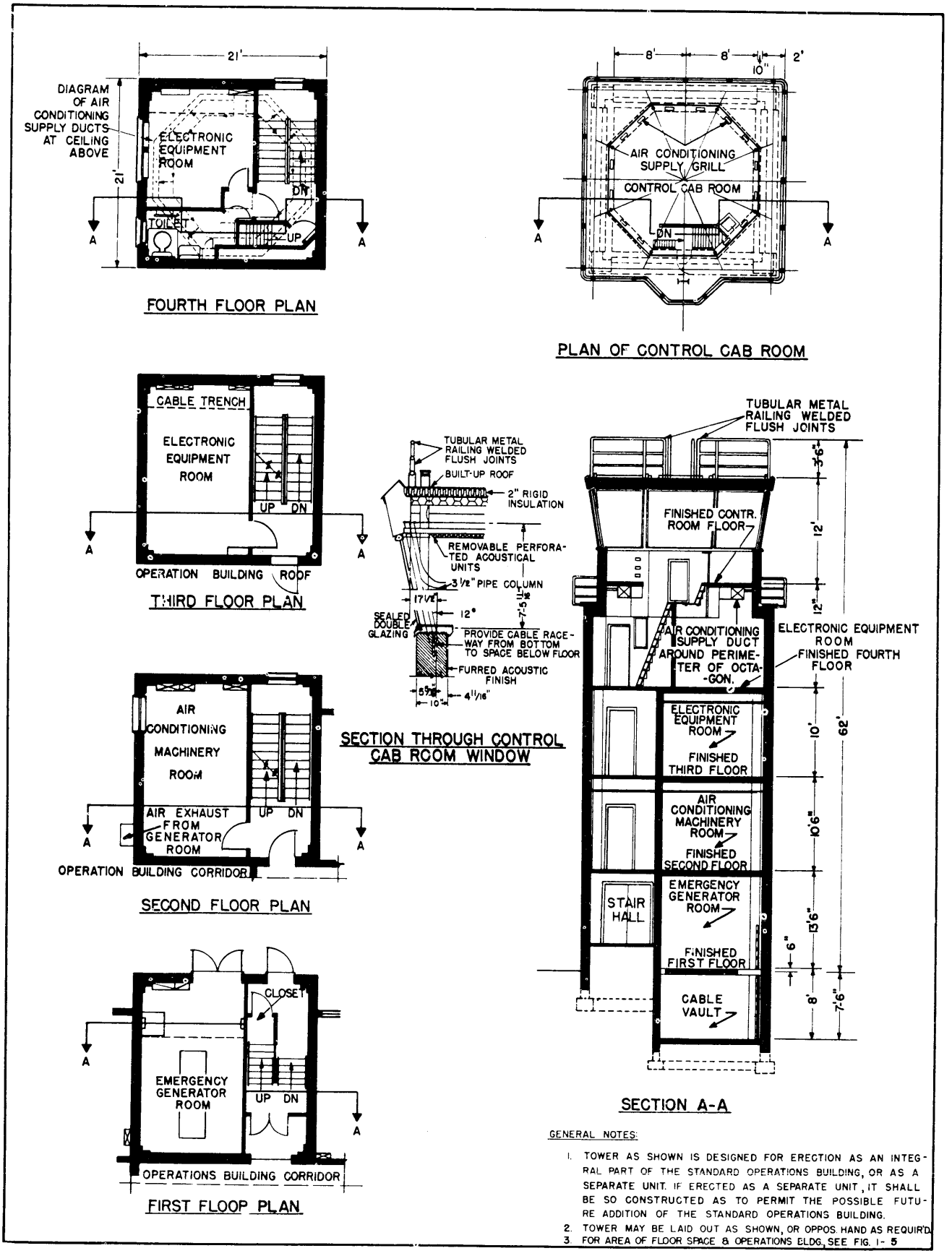


Figure 1-6. Standard Air Station Control Tower

transmitters can be installed in the same building.

Permanent-type standard remote transmitter buildings (HF) are in five graduated sizes, A, B, C, D, and E, with transmitter rooms of approximately 1,600, 2,400, 3,200, 4,000, and 4,800 square feet, respectively. (See figure 2-37.)

In some instances the standard remote transmitter building may be too large and in such cases the building should be patterned after the remote receiver building, figure 2-38.

VHF/UHF transmitters may be installed in HF transmitter buildings when there is line of sight to the runway system and antenna supports have been provided on the roofs for easy installation of steel masts, crossarms, dipoles, and lead-ins. Obstruction clearance then should be two degrees rather than the five degree clearance as specified for HF only.

A remote HF transmitter building may not be required at those activities for which transmitting facilities can be combined with those of a Naval Radio Station.

(*d*) VHF/UHF TRANSMITTERS. — To be located a minimum of 1,000 feet from the control tower, and 1500 feet from remote VHF/UHF receiver building, with unobstructed line of sight to the runways, taxiways and parking aprons; antenna supports to be not more than 35 feet in height, protected from obstruction (maximum permissible two degrees) resulting from growth of the station. (Should a separate frequency be required to control aircraft on the ground and while taxiing, the transmitter and receiver for this service may be installed in the Control Tower if the requirement for "line of sight" to taxi-ways and aprons should compromise air/ground coverage from a common site.)

Plot area required for this installation which is the same as for receivers is not over 200 feet square (approximately 1 acre) (figure 1-7). On stations having a high frequency transmitter building meeting the above requirements, the VHF/UHF transmitters may be installed at this location.

(*e*) HIGH FREQUENCY RECEIVERS.—To be located a minimum of three miles from high frequency transmitter site, 1500 feet from radar installations, 1000 feet from highways, industrial or housing areas, open wire power lines, and station roadways.

Maximum antenna height—115 feet, actual height to be determined by the Maintenance Authority.

Plot area required: a minimum of 1,300 foot square (38.8 acres) surrounded by a 1,000 foot protective zone, total 250 acres. (Figure 1-8.) The outer areas may be used for agricultural or other similar purposes subject to criteria restrictions.

Antenna requirements consist of four to six sleeve antennas with multicouplers, and other types such as "long wire" or directional antennas as required.

When the facilities of a Naval Communication Station or Naval Communication Facility are available, HF receivers, other than tower and emergency, will be installed at the Naval Communication Station or Naval Communication Facility.

(*f*) VHF/UHF RECEIVERS.—To be located a minimum of 1,500 feet from HF and VHF/UHF transmitters, 1,500 feet from radar installations, 1,000 feet from highways, industrial and housing areas, open wire power lines, and station roadways. Antenna requirements are comparable to those for transmitters.

Plot area required, 200 feet square with a surrounding 1,000 foot protective zone, total area 102 acres (figure 1-7).

(3) CONSTRUCTION:

(*a*) BUILDINGS.—Buildings shall be, unless otherwise specified, permanent reinforced concrete especially designed for the purpose intended. The Bureau of Ships and Bureau of Yards and Docks will provide plans for standard structures, expandable in increments. Buildings shall be of such size as to permit 25% expansion of electronic equipments, over and above current Chief of Naval Operations operational requirements for new construction. Acreages specified under SPECIFIC REQUIREMENTS are planned for comparable antenna expansion.

Provision should be made for adequate fire protection, but automatic sprinkler systems are not authorized for electronic equipment spaces.

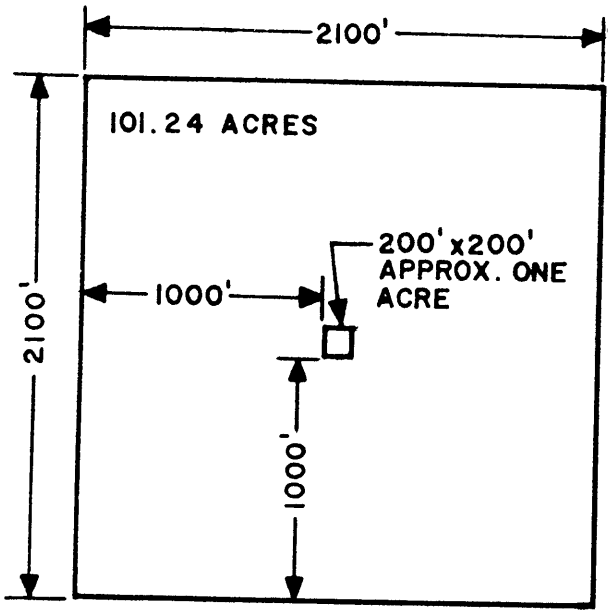
A standard medium generator building accommodates a generator power range of approximately 60 to 160 kw at 0.85 power factor (Yards and Docks Drawing 566,655). A standard large generator building accommodates a generator power range of approximately 160 to 400 kw (Yards and Docks Drawing 566,656). Both buildings cover the estimated power range requirements for all five buildings housing electronic equipment.

All buildings will require underground radio-frequency cable, communication cable (telephone type) and power cable; control cables to be as far removed as possible from the power cable entrance.

(*b*) UTILITIES:

1. POWER.—The capacity of the primary source of power is as described in 1-5, and, where provided, the station standby plant is considered adequate for auxiliary power provided separate feeders are installed.

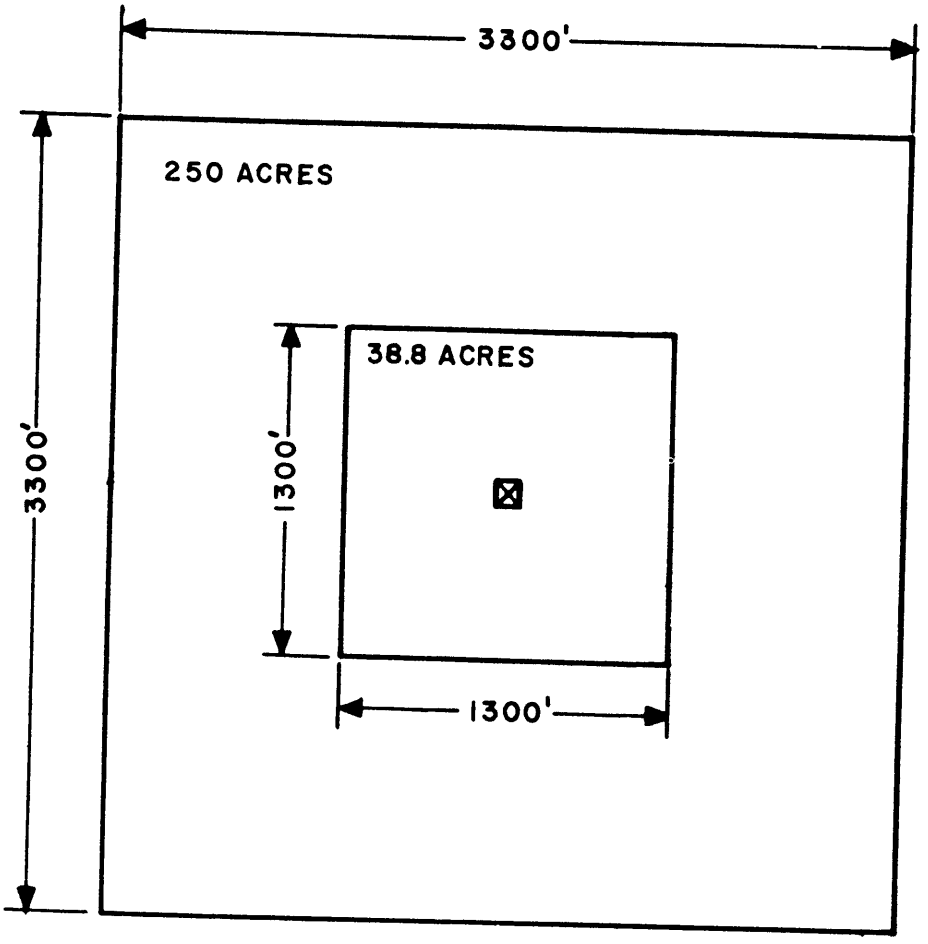
For emergency power at each site an automatic start switch-over plant, with manual features,



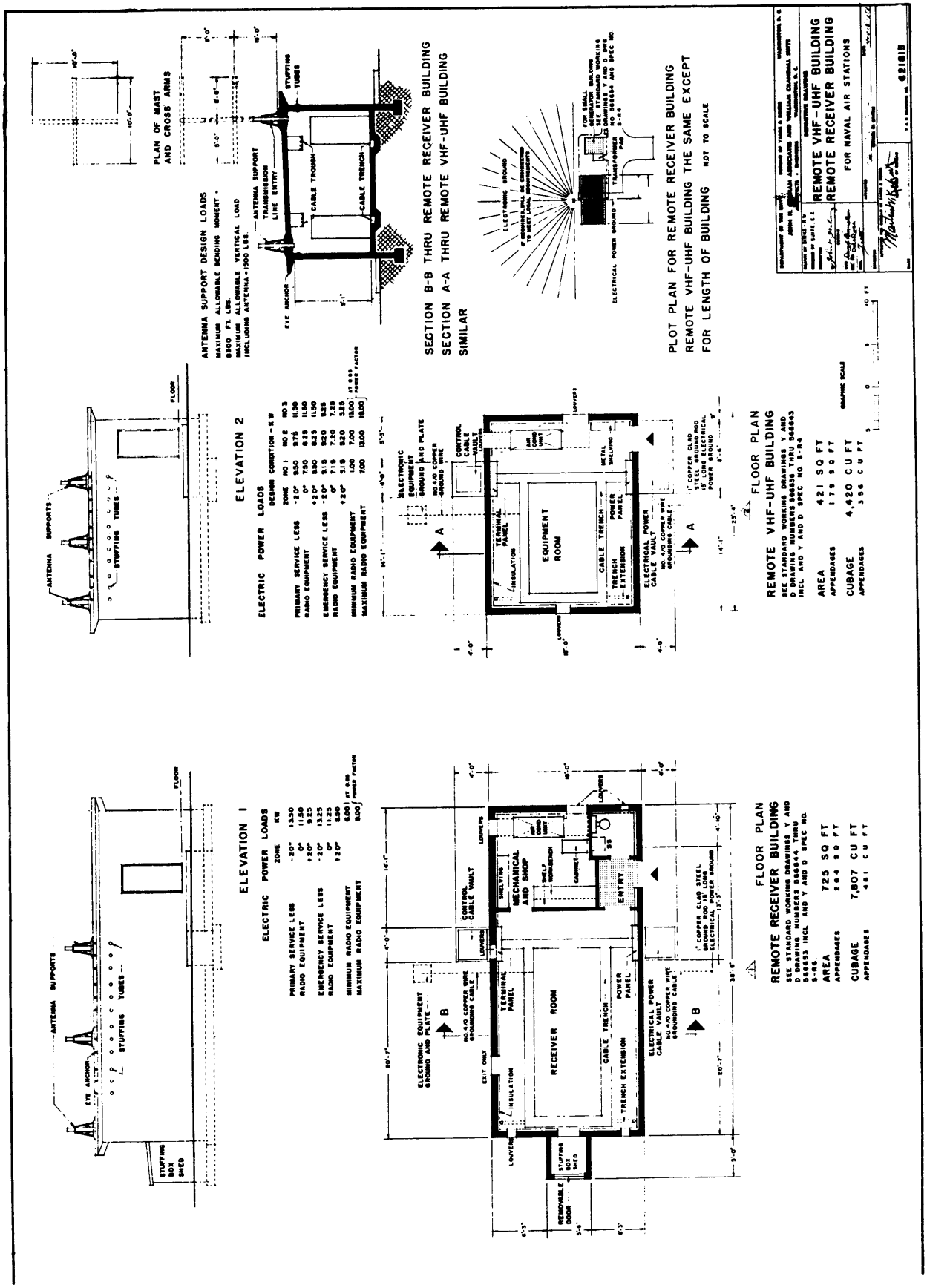
NOTE:

OUTER ZONE SPACE MAY BE USED FOR DEAD OPEN STORAGE IF HEIGHT IS KEPT TO A MINIMUM.

Figure I-7. VHF/UHF Receiver Site—Plot Plan



Figur I-8. HF Receiver Station—Plot Plan



Figur 1-9. R mot VHF/UHF Building — R mot HF R c iv r Building

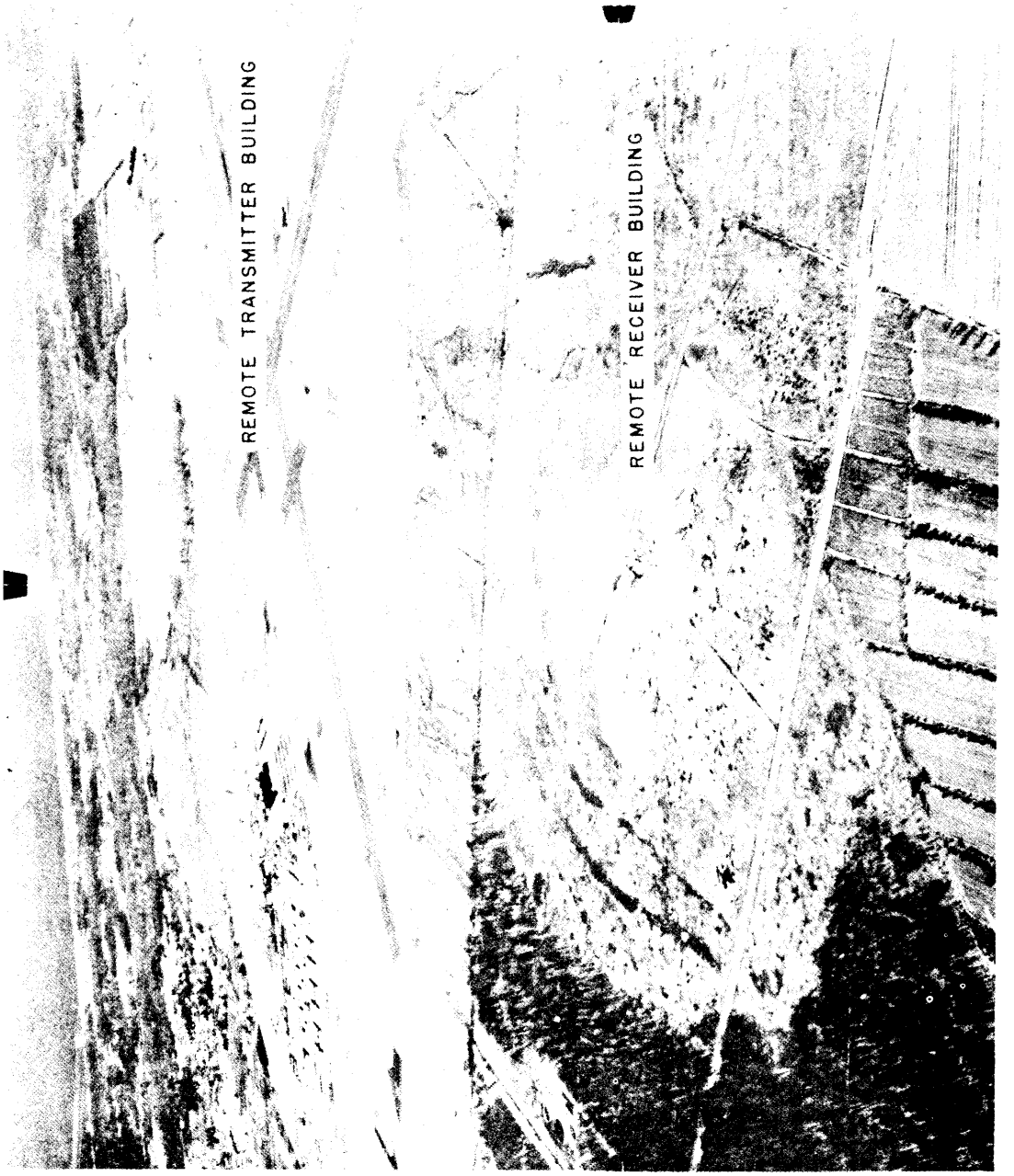


Figure 1-10. Airfield Remote Receiver and Transmitter Building Sites

capable of carrying a minimum of 100% of the electronic load, plus minimum utilities requirements, will be provided. Where economically feasible, 100% emergency power should be provided which may also serve as standby power.

2. CONTROL CHANNELS.—Determination of means of control, i.e.: cable or radio link, shall be made in each case based on economic and terrain factors. Where cables are used, the minimum requirements to provide control facilities between the operations building and remote units are shown in Bureau of Yards and Docks Drawing No. 562,560, Standard Operations building and Control Tower.

e. AIR NAVIGATIONAL AIDS AND TRAFFIC CONTROL FACILITIES.—All Fleet support air activities and Naval all-weather air activities are equipped with air navigational aids which are equal or superior to the minimum requirements under CAA standards. The following listed navigational aids and control components are standard facilities and most Naval air stations or bases will have one or more of these facilities depending upon operational requirements.

Radar Air Traffic Control Center (RATCC).
Fixed GCA.
Mobile GCA.
VHF/UHF direction finders.
LF/MF four course radio range.
VHF range stations (omni-range).
Air surveillance radar installations.
Radar beacons.
VHF fan marker beacons.
UHF omni-range.
"H" facility, L/MF homing, UHF homing.
Instrument Landing System.
Aircraft Guidance Central.

(1) RATCC.—Radar Air Traffic Control Center (RATCC) facility is made up of the following components shown in figure 1-11:

(*a*) Medium-range air traffic control radar, capable of detecting aircraft in line-of-sight ranges of approximately 100 miles and at altitudes of 40,000 to 50,000 feet. This is a fixed facility, permanently housed, with antenna elevation sufficient for 360° coverage and maximum scanning radius. It is not remotely controlled but does supply remote indicating devices located in the traffic control center.

(*b*) Short-range air traffic control radar, similar or equal to the search portion of the AN/MPN-5, capable of detecting aircraft to line-of-sight ranges of approximately 20 to 50 miles and altitudes of 10,000 to 15,000 feet. This is a fixed facility, housed and located so as to have an unobstructed view of the touchdown point of all runways to be serviced, particularly the instrument runway. For technical reasons, its location should be no closer than one-half mile to the nearest touchdown points. This component supplies information to remote indicating devices located in the traffic control center and is also remotely controlled from the traffic control center.

(*c*) Precision approach radar (PAR), similar or equal in performance to the final approach radar of the AN/MPN-5, capable of providing information required for safe final approach of single or multiple aircraft to a runway during weather conditions of 50 foot ceiling and one-fourth mile visibility. This is a mobile facility, trailer mounted, located on a hardstand adjacent to the runway to be serviced. It supplies information to the final approach controllers using remote indicating devices located in the traffic control center. It is also controlled by remote control from the traffic control center.

(*d*) Air traffic control room, located in the operations building, or in a separate structure when required by necessity; and accessible to the visual control tower. The room contains remote indicating scopes and control consoles for each of the above radars, as well as VHF/DF, UHF/DF, communications equipment, IFF equipment, and certain other maintenance and operational controls. In addition, large direct-view situation displays and plot boards for both traffic control radars and a selective communications and intercommunications systems are provided. Except for communications equipment needed for emergency operation, RATCC uses the standard air activity communications equipment, as required.

(2) FIXED GCA.—The fixed GCA (ground controlled approach) system consists of all components of the RATCC facility as described in the preceding paragraphs with the exception of the medium range air surveillance radar. Specifications as to the location of the fixed units and traffic control center operation are as described. At air activities where such fixed components only are installed, the services of a medium range air surveillance radar is usually provided by another local activity or by another agency such as CAA.

(3) MOBILE GCA.—Mobile GCA is a complete facility contained in three vans parked on a hardstand adjacent to the runway to be serviced. One van contains the radar equipment and operating personnel; the other, the emergency power generating equipment and tools. A third vehicle is provided to house the maintenance parts and facilities. Newer types of equipment require only one controller for each airplane and will be capable of operating up to three plane

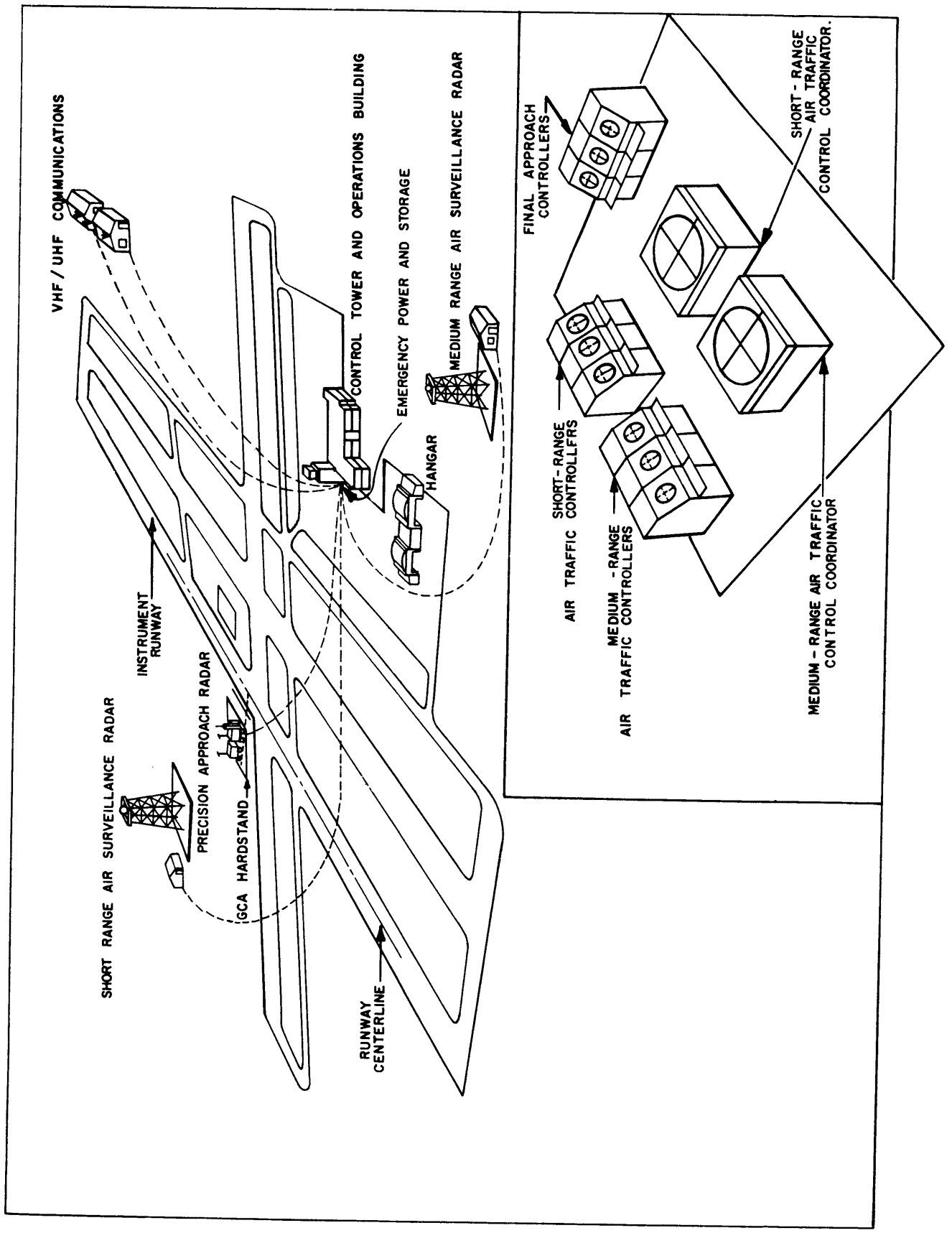


Figure 1-11. Radar Air Traffic Control C nt r (RATCC)

simultaneously on final approach. Installations include MF/HF/VHF/UHF communication facilities, VHF/UHF direction finders, and a completely selective intercommunication system. The mobile units are more often used because of their flexibility; frequently, increased runway requirements necessitate a change in the location of the field equipment. The GCA unit must be accurately sited by transit and true measurement.

(4) VHF/UHF DIRECTION FINDERS.—Direction finders are installed at Naval Air Stations to supply course guidance for aircraft into the area of GCA control. The VHF/DF is normally located in the control tower with its antenna located in a clear area on top of the control tower. The UHF/DF antenna may be mounted on top of the control tower or remotely located up to 1,000 feet from the indicator/control unit. In locations where RATCC or fixed GCA is installed, additional VHF and UHF direction finder service will be required. Both VHF/DF and UHF/DF are installed in mobile GCA units. Azmuth information to aircraft is via normal communication channels.

(5) LF/MF FOUR COURSE RADIO RANGE.—This navigational aid utilizes keyed figure of eight transmissions in a short-baseline system to provide time interlocked A and N keyed transmissions, modulated by 1020 cps, with provision for simultaneous voice transmissions. Present Naval installations are usually located approximately four and one-half miles from the Naval air station with one of the four courses sighted along the center line of the instrument runway. The system is now considered obsolescent in domestic United States.

(6) VHF OMNI-DIRECTIONAL RANGE.—The visual omni-directional range (VOR) is a short distance omni-directional radio range operating in the static-free portion of the VHF band (112-118 mc) and gives radial lines of position. The principle of the omni-directional range is the comparison of the phase between two audio signals when this difference in phase is made to vary with azimuth. One signal has a constant phase throughout the 360 degrees of azimuth, and is called the reference phase. The difference in phase between the received signals indicates the position of the aircraft in azimuth. An aircraft receiving these transmitted signals on its VOR equipment has a direct reading visual indication of the true bearing of the transmitting antenna (range station) as seen from the aircraft.

The range station equipment may be either portable or fixed and should be located off the end of the instrument runway at a distance of five to eight miles if practicable. Operating characteristics require that no objects of any type lie within 1,000 feet of the equipment in any direction. Small objects are permissible in the 360° area from the 1,000 foot circle to the 2,000 foot distance. Twenty KW 230 V. single phase station/commercial power recommended. Emergency engine generator included in the mobile equipment. If a suitable "off station" site is not available, equipment may be located "on station."

(7) AIR SURVEILLANCE RADAR INSTALLATIONS.—Air surveillance radar (ASR) facilities may be classed in two categories when part of air traffic control centers, (1) medium range, and (2) short range; both installed as prescribed for RATCC utility. The medium range facility may be located so as to serve more than one air activity with intercommunication between activities as necessary, and remote display at any operating center as necessary and feasible. The short range facility, as part of GCA, having precise location with respect to terrain and flight in the approach area, is installed as prescribed for RATCC operation. Other secondary air surveillance radars may be installed by activities where, because of terrain factors, complete coverage cannot be obtained by primary fixed or mobile GCA radar installations. In these cases, provision must be made for remote display and control if necessary; and for video, control, and communication link features as required. Installation parameters concerning these radar facilities include:

(*a*) Elevation so as to obtain 360° or maximum line-of-sight coverage.

(*b*) Approach zone and general aircraft obstruction clearance.

(*c*) Proximity limitations with respect to touchdown points (1,500 feet for primary short range radar).

(*d*) Proximity to communication facilities (interference generation).

(8) RADAR BEACONS.—A radar beacon or RACON is installed at an air activity to furnish aircraft with range and azimuth information. When a suitable radar pulse is received by the beacon it is greatly amplified and retransmitted. The returning signal is received by the plane and displayed on its indicator. The bearing and range of the beacon is determined in the same way as for an ordinary echo or reflected signal. When "interrogated" properly by an aircraft, the "reply" from the beacon is characteristically coded to enable the pilot to identify the beacon. Consideration must be given to the following factors concerning radar beacon installation:

(*a*) Line-of-sight coverage.

(*b*) Approach zone and general aircraft obstruction clearance.

(*c*) Proximity to communication facilities.

(*d*) Power availability.

(*e*) Geographical location.

(Beacon location is reported to the Hydrographic Office and positioned in navigational aid literature in degrees of latitude and longitude.)

(9) VHF FAN MARKER BEACONS.—This radio beacon performs the function of providing a positive indication of position at a point along an airway by radiating an identification signal which is broad in a plane perpendicular to the airway and narrow in a plane along the airway. The radiated (75 mc) signal may be either voice modulated or modulated by a 3000 cps identification tone. The facility is usually housed in a standard pre-fabricated structure with power supplied by power lines. Site selection for the facility must be carefully made with due regard for the purpose of the beacon and is generally located on any of the radio range legs and at a distance of approximately three miles from the range station.

(10) UHF OMNI-RANGE. — This equipment operating in the UHF band, is a continuous duty radio omni-directional beacon. It consists of both transmitting and receiving equipment either permanently housed or mobile trailer-mounted. Arrangement is provided whereby aircraft equipped with the proper radio facilities can obtain instantaneous range and beaming information. The radio beacon output consists of the beacon's identification call, distance information signals, and bearing information signals. The optimum height at which the TACAN ground equipment (AN/URN-3) antenna should be installed is a compromise among the following factors:

(*a*) Line-of-sight coverage.

(*b*) Obstruction and terrain clearance.

(*c*) Gaps in solid coverage.

(*d*) Cost and installation difficulty.

(*e*) Reliability and maintenance difficulty.

(*f*) Antenna height limits for locations near runways.

(11) "H" FACILITY, L/MF, UHF, HOMING. —The L/MF radio beacon operates in the 200-800 kc range using 1020 cps or voice modulation. Aircraft equipped with proper D/F equipment can use this beacon for homing. Equipment is generally housed in a pre-fabricated shelter with a 100-foot long, 50-foot high, top-loaded tee antenna system. Location planning will include the following factors:

(*a*) Power availability.

(*b*) Site clearance.

(*c*) Approach zone and general aircraft obstruction clearance.

An "H" facility is normally located at a fan marker site or eight to ten miles distance from the air station on the center line of the instrument runway if feasible. It is used as an aircraft holding point in addition to homing.

The UHF homer provides the same service as the L/MF homer and can be located at a range station or other location listed under L/MF homers.

(12) INSTRUMENT LANDING SYSTEM (ILS).—This system provides a means whereby aircraft properly equipped may be guided to a safe landing under conditions of low visibility. The system consists of localizer, glide slope, inner, middle and outer markers, and homers with monitors located at the control tower. Only two Navy systems are in operation and no additional installations are currently planned.

(13) AIRCRAFT GUIDANCE CENTRAL. — This facility consists of the following NavAids equipment installed in a mobile trailer and suitably located at an air activity:

(*a*) UHF homer.

(*b*) L/MF homer.

(*c*) Radar beacon

(*d*) Radio sector homer.

Test equipment, maintenance parts and emergency engine generator power are also included. A power supply of 20 KW 115 V. single phase station/commercial is recommended. Hardstand location is desirable but not required.

f. RADAR INSTALLATIONS.—Site selection and installation of radar equipment at shore activities is governed by considerations including:

Application.

Terrain.

Housing of equipment and tower construction if required.

Power availability.

Provision for remote control and remote display if required.

Special provisions for training.

(1) APPLICATION.—Radar installations have the following applications at various shore activities as indicated:

(*a*) Air surveillance, medium and short range air search; air stations.

(*b*) Precision approach radars; components of GCA at air stations.

(*c*) Radar beacons; air navigational aid.

(*d*) Surface search; components of harbor defense.

(*e*) Search and fire control radars; training activities.

(2) TERRAIN.—Normal requirements is for optimum elevation above the surrounding terrain to obtain maximum line-of-sight coverage with a minimum of transmission line loss. Soil conductivity or isolation from sources of noise are not site requirements for radar installations.

(3) HOUSING AND TOWER CONSTRUCTION.—Standard plans are available for the construction of housing for radar equipment including towers for the radar antenna if required. This includes provision for rotation of the antenna and transmission line or waveguide coupling to the antenna. Space requirements include space for operation and maintenance of equipment.

(4) POWER.—Normally obtained from station or commercial sources. Provision for standby or emergency power will include automatic, gas or diesel motor generator operation as well as fuel storage.

(5) REMOTE CONTROL AND DISPLAY.—Involves the installation of control and video lines between radar equipment and control center. Where the radar is located at a point separated from control by considerable distance, employment of leased wire service over commercial telephone lines, or microwave links, may be indicated.

(6) TRAINING.—Radar installations at training facilities involve special requirements depending upon training application. Equipments required for training in maintenance may not require antennas, stabilizers or indicators, and operational training may require the installation of special target simulating devices.

g. TRAINING ACTIVITIES.—Electronic criteria applicable to training activities are similar to that of other electronic facilities established ashore, but, each training activity has special requirements that are peculiar to itself. The purpose of the training activity must be considered when electronic material is installed. Where the training is operational such as in a CIC school, the equipment arrangement is such as to, as nearly as possible, duplicate the arrangement of a shipboard installation. If the purpose of the school is to train personnel in theory and maintenance, the equipment arrangement would be such as to provide maximum accessibility. If the activity is functional in nature such as at a Naval Reserve Radio Station, the equipment arrangement would follow the general arrangement of a regularly established communication station so far as possible with modification as required by local conditions.

Planning for the establishment and maintenance of training facilities involves a different consideration of such factors that are fiscal or logistic, inasmuch as the management bureau and technical bureaus occupy positions differing from those applying to regular electronic facilities.

The following outline includes training facilities for which there are electronic requirements:

(1) Naval and Service School Commands.

(2) Fleet Training Centers.

(3) CIC Schools.

(4) Sonar Schools.

(5) Naval Reserve Training Centers.
- (*a*) Communications.
- (*b*) Radar.
- (*c*) CIC.
- (*d*) TTY and RATT.
- (*e*) Sonar.

(6) Naval Reserve Electronic Facilities.
- (*a*) Communications.
- (*b*) Radar.
- (*c*) CIC.
- (*d*) TTY and RATT.

(7) Naval Reserve Electronic Stations.
- (*a*) Communications.

(8) NROTC Schools.

(9) Miscellaneous Schools.
- (*a*) Naval Academy.
- (*b*) P.G. Schools
- (*c*) Naval War College

h. HARBOR DEFENSE FACILITIES.

(1) GENERAL.—The term Harbor Defense applies to the protection of a harbor or anchorage and its approaches against submarines, small craft, enemy mine laying operations, and sabotage. It embraces a broad field of activities, the extent of which depends upon the mission of the base or other facilities supported by the harbor.

Planning for harbor defense inevitably presents a multitude of problems which must be anticipated and weighed to provide adequate protection to the area involved. These problems cannot be solved separately, but must be considered in relation to the overall problem.

(2) HARBOR SURVEY.—Any underwater harbor defense detection system is basically a device for recording one of the normal physical properties of the harbor environment. The approach of a stranger produces a change in that environment—an echo

where none existed, an altered magnetic field, a screw noise. The presence of an interloper is recognized by the change he causes. It is obvious, therefore, that the basic physical properties of a harbor environment must be studied as one of the primary stages in harbor defense planning. The planning must insure, as far as possible, that the detection systems are recording artificial changes in the environment caused by intruders, and are not responding to natural changes.

Oceanography enters into harbor defense at several stages. Certain features of a harbor may determine in advance whether a given system can be employed. For example, the operation of magnetic loops requires that the conductors be motionless on the bottom. In an area of irregular rocky or coral bottom, magnetic loops are likely to lie in bights that sway and create signals in tidal currents of only moderate intensity, or even in the presence of large waves. At another stage in planning, the environment must be studied to determine the most suitable locations for planting underwater detection equipment. Sonic devices must not be placed in topographic "shadows." Their spacing will depend on sound propagation conditions. The characteristics of the bottom—whether it is sand, mud, or rock—will also influence choice of sites. Detailed information pertaining to harbor survey as well as facility planning is contained in current publications.

(3) HARBOR DEFENSE INSTALLATIONS.—The below listed facilities are generally included as components of a complete harbor defense installation. A part, or all of these components may be installed for the protection of any one harbor depending on environmental and tactical requirements.

(*a*) Heralds (short and long range).
(*b*) Hydrophones, cable connected.
(*c*) Radio-Sono Buoys.
(*d*) Magnetic Indicator Loops.
(*e*) Precision Navigation Equipment.
(*f*) Controlled mines.
(*g*) Radar.
(*h*) Communication equipment.
(*i*) Infrared facilities.

Each component requires precise location as well as careful installation with provision for shore control by means of submarine cable or radio link if required. These components, together with the permanent or semi-permanent shore installations, and facilities for installation and maintenance, comprise the main components of a complete harbor defense system.

Standard plans are available for siting and construction of a Harbor Entrance Control Post, radar installation and other shore facilities of the system. Mobile equipment includes tug boats, barges, cranes, and other water-borne facilities as well as transportation, mobile radar and power equipment as required ashore.

i. RADIAC REPAIR FACILITIES.—In view of the special facilities required for the repair and calibration of radiac equipment and the personnel hazard involved in the use of radioactive substances required for this work, the Bureau of Ships recommends that there be no unnecessary duplication of radiac repair facilities. Accordingly, the current radiac maintenance plans and policies established by the Bureau of Ships provide for appropriate radiac repair facilities in each Naval district. These facilities are established for the purpose of serving the fleet and all shore activities, including all Bureaus, offices and activities using radiac equipment. Maintenance of radiac equipment by the using activities is to be limited to minor repairs which do not affect calibration. The cognizant maintenance authority establishes, schedules, and performs the necessary routine maintenance.

Standard plans are available for the establishment of radiac repair facilities with criteria which include:

Hazard area.
Equipment requirements and arrangement.
Space requirements.

j. HIGH FREQUENCY RADIO DIRECTION FINDER (D/F) FACILITIES.

(1) GENERAL.—A radio direction finder facility is an important and vital component of the Naval Shore Establishment. Its primary mission is to determine the exact location of any transmitted radio signal, and it is highly effective in anti-submarine warfare, search and rescue efforts, and location of unfriendly transmitter stations.

(2) METHOD OF TRACKING.—To determine the exact origin of a transmitter radio signal, a control center instructs two or more D/F facilities to take a fix (true bearing) on a radio signal of a certain frequency and located in a definite sector. The more facilities taking a fix on a questionable signal, the more accurate will be the determination of its location. Each facility advises the control center of its fix, which is then plotted. The point of intersection of all fixes is the source of the questionable signal.

(3) COMPOSITION.—A self-supporting D/F facility consists of two distinct areas about three and one-half miles apart. One is called the operations area, and the second the logistic or transmitter area. Both areas shall be served with the following public utilities, if available: telephone, electric power, water, and sewerage.

(*a*) OPERATIONS AREA.—The operations area consists of approximately 180 acres containing: (1) the operations building with its attendant direction finder antenna arrays, (2) auxiliary power building, and (3) access road with a parking area. Receiving facilities are provided only when they are not available at a nearby Communication Station.

If public utilities are not available, the auxiliary power plant becomes the primary power with auxiliary power backup. Water must be obtained by the most economical method. A communication line must be installed between the operations area and the logistic area.

(*b*) LOGISTIC AREA.—The logistic area consists of approximately 60 acres containing: (1) a utility building, auxiliary power, workshop, storage, and garage, (2) barracks building with galley and messhall for 24 enlisted men and one officer, and (3) road with parking area. If public utilities are not available, the auxiliary power becomes the primary power with auxiliary backup, and water is obtained by drilling a well or any other appropriate means. Transmitting facilities including necessary antennas are provided only when they are not available at a nearby Communication Station.

(4) SITE CHARACTERISTICS.—The site for the operations building and the D/F arrays should be as flat as possible and meet the following requirements:

(*a*) Good ground conductivity.

(*b*) Low noise level.

(*c*) Homogeneity of soil, free of all conductors, such as pipes, cables, wires, rails, and so on.

(*d*) Obstructions (buildings, trees, or mountains) not exceeding an angle of three degrees above the horizontal, with the center of the nearest antenna array the apex of the angle.

(*e*) A preferred minimum separation from the center of the nearest antenna array to various communications and power equipments.

(*f*) Ready availability of utilities (sewers, water, electric, telephone).

(*g*) Easy access to roads.

k. CONTROL LINK FACILITIES.

(1) GENERAL.—The various components of a Naval Communication Station [Naval Radio Station (R), (T), (S), and Communication Center] are interconnected by communication control circuits for keying and control, and for passing information between units. Other activities such as Naval Air Stations also use such circuits for remote control of equipment. These circuits may be telephone-type cable pairs (either leased or Government-owned), or special short-range (from 25 to 30 miles) radio equipment commonly known as CCL (communication control links). The choice of which facility to use is a command responsibility based on physical security, cost, and importance of such control circuits.

In general, control cables are preferred if the entire cable route is through government owned or controlled property, and such cables should be government owned, separate from commercial telephone circuits where such telephone service exists. When the control line route is outside of direct control, and physical security is questionable, (cables subject to pilferage or tampering), the radio link is preferred.

Microwave links properly engineered and installed are as reliable as cable, are preferred to cables from the engineering standpoint, and do not require cable backup. VHF links have not been sufficiently reliable to be used as *primary* control circuits and, therefore, have been installed as secondary circuits with cables performing primary service.

Economic factors such as tower heights, and whether or not relay stations are required, will influence the choice between leased wire service and radio links.

(2) OPERATING FREQUENCIES.—CCL equipment may be defined roughly by its operating frequencies. Presently installed equipment is almost entirely within the VHF range (from 132 to 152 megacycles). Some equipment operates in the 80- 100-megacycle and the 360- to 400-megacycle bands. Because the installation problems for these bands are almost identical, they will be considered as VHF for present purposes of discussion.

For practical reasons, no new major installation will be made in the VHF range except, possibly, at overseas locations in isolated areas. VHF equipment now installed is being replaced wherever possible, on a planned basis, with microwave equipment operating in the 1,700- to 2,400-megacycle range. (Radio frequencies above 300 mc are called "microwaves".)

(3) VHF REQUIREMENTS. — Installation of VHF equipment, including antennas, requires a location free from radio noise, with particular attention paid to isolation from vehicular traffic. (An interference survey must be conducted by electronics specialists prior to installation.) Antennas should be located to provide an optical line of sight between the antennas on both ends. Under favorable conditions, this requirement may be minimized, but the decision is to be made by qualified electronics personnel and based upon actual measurements. Connection between the antenna and other equipment, however, is to be of minimum length.

Ordinarily, the connection between antenna and equipment will be solid, dielectric coaxial cable, such as RG-17/U and RG-8/U, and antenna supports will be rigid.

(4) MICROWAVE REQUIREMENTS.—Because microwave propagation paths are substantially "line-of-sight," installation requirements for microwave CCL equipment are much more stringent than for VHF. Each RF path (site-to-site) must be determined individually, and only general rules can be given here. Antenna heights must be such as to provide First Fresnel Zone clearance of all obstacles over a 4/3 earth-radius profile. If this cannot be obtained on a direct site-to-site basis, one or more intermediate stations, known as repeaters, must be used.

Path clearances are usually determined through study of profile charts. Profile charts are prepared by the Public Works Officer for each path showing the geographical location of each antenna in degrees, minutes, and seconds, and the bearing between the end points in degrees, minutes, and seconds. This profile also identifies the nature of the terrain (wooded, cultivated, water, and buildings). Tree and building heights are estimated and noted carefully for possible future tree growth or probable new building construction.

(5) TERRAIN.—Over a path of terrain of substantially flat earth or water, antenna heights other than those in the preceding paragraphs may be required. Such deviations represent difficult, technical decisions to be made only by the Bureau of Ships or designated representative.

Connection between antennas and RF equipment will ordinarily be made by air-pressurized coaxial transmission line.

(6) TOWERS.—Towers for microwave systems must be rigid structures. In the 1200-2400 mcs band, not more than a two degree center-line deviation of the antennas is permissible for either a six-foot or a ten-foot diameter parabola.

There is no requirement for location of microwave towers, antennas, and equipment in a radio-noise-free area.

(7) RADIO FREQUENCY (RF) HOUSE.—A small building to house the RF equipment must be provided at the base of each microwave tower (on the side of the tower toward the distant point, if possible) if the tower is more than 50 feet from the operations building and more than 200 feet high.

One run of buried coaxial cable (either in conduit or direct burial) is provided for each microwave transmitting or receiving circuit between the tower RF house and the operations building, and one 7-to-11 pair of telephone cable. Emergency a-c power is provided the RF house from the operations building emergency supply. Spare or alternate coaxial cable, telephone cables, and power lines are furnished as required by site considerations.

(8) REPEATER STATION BUILDING.—A microwave repeater station installation at an operating point is similar to the RF house and tower. At the repeater station, however, the RF building should contain a 10 feet x 20 feet equipment space, a 10 feet x 10 feet storage battery locker, and a 10 feet x 10 feet automatic-start engine generator space. It should also have a battery-driven dynamotor, an automatic-start engine generator, and the necessary chargers, switchgear, and so on. Separation between antennas and RF building, without special approval of the Bureau of Ships, is not to exceed 300 feet, and 1,500 feet between RF building and operations building.

RF houses and repeater station buildings are windowless structures with two-hour fire-resistance underwriters rating. Temperature in these buildings must be held between 55° F. and 85° F., with a relative humidity of 50 percent or below. The equipment will require 115-volt, 60-cycle, single-phase power, the load depending on station requirements.

1. RADIATION HAZARDS

(1) GENERAL.–Until recently, the radiated power output from Electronics equipment was low enough that it was not considered a serious personnel hazard, and information had been lacking on its effect on explosives. Recent developments in radar equipment with peak power of several megawatts, and communications equipment, such as tropospheric scatter equipment, with effective radiated power of several megawatts, makes it necessary to take this factor into consideration in the siting, construction and installation of Navy Electronics Shore Facilities, so that proper safety measures may be effected to safeguard personnel from damaging exposure, and that the handling and storage of explosives can be effected with a minimum amount of danger.

Two elements of personnel hazard are involved: (a) the microwave radiation itself, and (b) the hazard of ionizing radiation, especially that associated with unshielded klystron and magnetron tubes.

(2) EXPLOSIVES.–An exhaustive test and evaluation program concerning the electromagnetic radiation hazards to explosives is being carried on by the Bureau of Weapons, entitled "Hazards of Electronic Radiation to Ordnance" (HERO). Although the HERO program has not been concluded, present findings indicate the requirement for physical separation of certain ordnance items from sources of electrical energy. This separation has been established at 1000 feet.

In view of the above, no ammunition or explosives containing electro-explosive devices shall be stored within 1000 feet of any antenna. This refers to any antenna power at any frequency. Electro-explosive devices include rockets, guided missiles, nuclear ordnance, electric detonators, etc.

(3) PERSONNEL.

(*a*) BODY-EXPOSURE TOLERANCE.–The basic mechanism underlying injury to tissue exposed to RF energy is the absorption of heat within the tissue and a resultant rise in temperature. This rise in temperature continues until a steady state is reached–a result of balance between absorption of energy and the ability of the body to dissipate heat. In practice, the exposures of most concern are those to the total body, to the eyes, and to the testicles. It is generally believed that a temperature rise of 1 degree C. in body-core temperature is intolerable, that a rise of 10 degree C. in the eye may lead to cataract formation, and that a rise of 1-4 degree C. in the testicles may be productive of damage. In total-body exposure, eye damage is not the limiting factor; significant total-body temperature rise is the more serious hazard. Average heat dissipation under normal circumstances is equivalent to 0.005 watt/CM^2. Double this rate seems within the body's capability to dissipate heat.

Heat absorption by tissue varies with the frequency. Frequencies substantially below 1000 MC-500 MC and lower–produce true deep heating, the coefficient of absorption is about 30 to 40%. Frequencies from 1000 MC to 3000 MC may be absorbed completely. Frequencies in excess of 3000 MC are absorbed by the surface of the body, heat dissipation being excellent.

The critical field-strength flux for eye damage is 0.1 watt/CM^2; for testicular damage, 0.005 to 0.001 watt/CM^2; and for total body exposure, 0.01 watt/CM^2. Consequently, a tentative tolerance level of 0.01 watt/CM^2 has been accepted.

The above has assumed average temperate zone climatic conditions. To evaluate hazard in any specific case, consideration must be given to any environmental factors, such as humidity, ambient air temperature, clothing, presence of large amounts of metal or glass in neighborhood of personnel, body weight of individual, solar radiation, air movement, and the individual's physical activity, all of which are factors in the absorption and elimination of heat by the body.

(*b*) PREVENTIVE MEASURES.

1. All areas in which radio-frequency power densities of 0.01 watt/CM^2, or greater are present, will be considered as hazardous to health. Minimum safe distances can be calculated from theoretical measurements or actual test measurements.

2. The areas exceeding a power density of 0.01 watt/CM^2 will be appropriately posted and only personnel considered absolutely essential for work in these areas be permitted ingress. Periods of exposure in these areas should be kept to a minimum. Personnel engaged in servicing the equipment, or who must remain in the beam for any length of time, should be provided with–and required to wear–personnel equipment, such as eye protection equipped with wire-mesh screen.

3. Personnel will be warned that the most exposure comes from being directly in the beam and that direct examination of any microwave radiation, reflector, wave-guide opening, or wave-guide horn during periods of transmissions will not be made.

4. In the positioning of radiating devices, care should be taken to avoid reflecting the beam in such a manner as to expose personnel in adjacent areas. Where test procedures require free space radiation, the radiating devices should be located to avoid directing the energy beam toward inhabited structures or other personnel groupings.

5. Personnel will be prohibited from any work in the field of radiation of any energized antenna, waveguide, feeder horn structure or transmission line where the measured power density exceeds 0.01 watt/CM^2. (In the absence of known measurements, theoretical calculations will be used for guidance.)

6. The practice of discharging under test, the RF output of high power generators which produce average power levels of 0.01 watt/CM^2, or more, into the surrounding area, will be discouraged. Dummy loads, water loads, or other absorptive materials will be used to absorb the energy output of such equipment while being operated or tested.

7. Personnel who service or bench-test radar equipment may be exposed to ionizing radiation in addition to microwaves, depending on the type of radar in use. The presence of ionizing radiation should be determined; if radiation is present, personnel should be monitored by photodosimetry as outlined in NAVMED P-1325, Radiological Safety Regulations, and subsequent revisions thereof.

(4) MEASUREMENTS AND INSTRUMENTS.– Areas in which th more serious possibilities for damage arise are in the main lobe of the antenna, in backlobes, and from spurious reflections. Reflections from buildings and terrain features require measurement, as do backlobes and transmission-line peaks. Methods of field intensity measurement and test equipment required can be found in "Handbook, Radio Frequency Radiation Hazards;" T.O. 31-1-80, published by USAF, obtainable through normal Navy procurement channels, or at the Government Printing Office.

There has been produced a series of light, portable, battery-operated radiometers for measuring power density. Each meter covers one segment of the spectrum.

Another needed piece of equipment is a dosimeter for personal use by people exposed to microwaves. This hand-held dosimeter contains a broadband transducing material–a small mass of gelatin, simulating an avascular body structure–which absorbs microwave energy and translates it into heat; and a thermistor to translate the heat into a meter reading.