MG-101

project
mercury

INTRODUCTION TO PROJECT MERCURY AND SITE HANDBOOK

prepared for
National Aeronautics and Space Administration
Contract No. NAS 1-430

September, 1960

WESTERN ELECTRIC COMPANY, INC.
220 Church Street, New York 13, N. Y.

SCOPE OF THE MANUAL

The Introduction to Project Mercury section of this manual presents a brief explanation of (1) the mission concept and flight control, (2) the capsule-to-ground communications systems, and (3) the ground tracking and network system. This information is to acquaint the reader with the overall content of the Mercury program and the operational modes of the various capsule and ground instrumentation, but does not include the technical details of systems presented in other manuals.

The Site Handbook, also included as a part of this manual, is prepared for those engaged in the various ground support functions as well as for general purpose information. A brief description of instrumentation found at the various sites is included, with pertinent drawings and block diagrams. Other information is included relative to living conditions, geographical location, health conditions, and passport information that will be of assistance to personnel assigned to these areas.

It will be noted that each section of this manual has its own page numbering and indexing system. This is done to facilitate issuance of each section independently of the other, should this be desirable.

INTRODUCTION
to
PROJECT MERCURY

FOREWORD

The Introduction to Project Mercury presents a brief explanation of (1) the objectives of the mission, (2) ground monitoring and control, (3) the flight sequence, (4) the air-to-ground communications system, and (5) the personnel assigned to the mission. The information is general; it does not include technical details of systems that are described in manuals specifically written for those systems.

ERRATA

Sec.	*Page*	*Paragraph*	*Figure*	*Correction*
MG-101-1	3	Emergency Prov.		Change period to a comma at the end of the first sentence.
MG-101-2	2-9	2.4		Change Figure 2-6 to Figure 2-5.
MG-101-2	2-21		2-3	In the "explanation of the figure" example, operation of key 11 should read operation of key 10 and refers to the "Operations Loop."
MG-101-2	3-22		3-14	Rhokbie should be Rhombic.
MG-101-2	4-16		4-7	This should be figure 4-7A.
MG-101-2	4-28		4-15	Under Area 1 of the Legend delete "and Communications Area." In the Communications area: change manual position 522 to 552.
MG-101-2	6-5	6.4		Figures 6-22, -23, -23—Muchea should read 6-22, -23, -24—Muchea.
MG-101-2	7-5	7.2.7		The reference to Figure 7-6 should read Figure 7-8.
MG-101-2	7-11		7-3	This figure should be designated Figure 7-3A.
MG-101-2	7-12		7-5	This figure should be designated Figure 7-3B.
MG-101-2	8-12		8-4	This figure should be designated Figure 8-4A.
MG-101-2	8-13		8-4	This figure should be designated Figure 8-4B.
MG-101-2	8-14		8-5	This figure should be designated Figure 8-5A.
MG-101-2	8-15		8-5	This figure should be designated Figure 8-5B.

TABLE OF CONTENTS

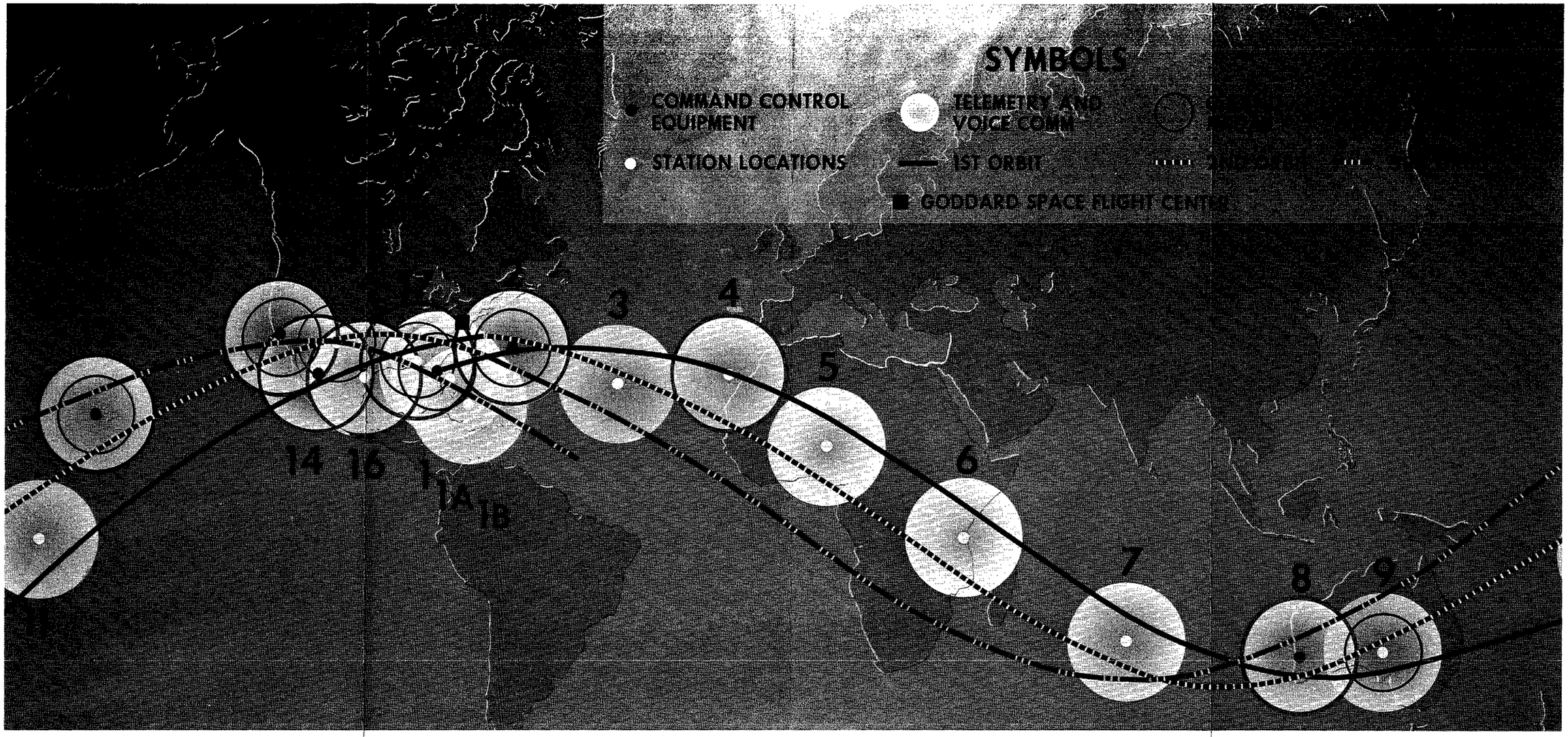
Title	*Page*	*Title*	*Page*
Objectives of the Mission	1	The Capsule	5
Ground Monitoring and Control	1	Physical Description	5
Normal Mission Description	3	Communications System	5
Emergency Provisions	3	Other Capsule Systems	11
Recovery Provisions	5	Personnel Assignments	11

LIST OF ILLUSTRATIONS

Figure	*Title*	*Page*	*Figure*	*Title*	*Page*
1	Network Station Distribution	viii	5	Mission Sequence	7
2	Flight Vehicle	2	6	Prime Recovery Areas	9
3	Launch and Insertion Stages	4	7	The Capsule	10
4	Reentry and Recovery Stages	6			

LIST OF TABLES

Table	*Title*	*Page*	*Table*	*Title*	*Page*
1-1	Master Functional Block Diagram Numbering System	1-5	1-2	Subsystem Functional Block Diagram Numbering System	1-5



LEGEND

1. CAPE CANAVERAL, FLORIDA
1a. GRAND BAHAMA ISLAND
1b. GRAND TURK ISLAND
2. BERMUDA
3. ATLANTIC SHIP
4. GRAND CANARY ISLAND
5. KANO, NIGERIA
6. ZANZIBAR
7. INDIAN OCEAN SHIP
8. MUCHEA, AUSTRALIA
9. WOOMERA, AUSTRALIA
10. DELETED
11. CANTON ISLAND
12. KAUAI ISLAND, HAWAII
13. POINT ARGUELLO, CALIF.
14. GUAYMAS, MEXICO
15. WHITE SANDS, NEW MEXICO
16. CORPUS CHRISTI, TEXAS
17. EGLIN, FLORIDA

FIGURE 1. NETWORK STATION DISTRIBUTION

INTRODUCTION TO PROJECT MERCURY

OBJECTIVES OF THE MISSION

Project Mercury is the initial United States Government program directed toward manned orbital flight. The major objectives of Project Mercury are to:

a. Place a manned space capsule into a prescribed orbit around the earth and to successfully recover the capsule and its occupant at the conclusion of the mission;

b. Investigate the capabilities of man-in-space environment, including launch and reentry accelerations and weightlessness during orbit;

c. Evaluate the engineering and operational aspects of flight preparations and inflight monitoring with emphasis on flight safety and mission control.

To accomplish these objectives, a series of manned capsules will be placed in orbit. The capsule will make one, two, or three passes around the earth, and then reenter and land in a predetermined area in the Atlantic Ocean. A network of ground tracking and communications stations at various points around the earth monitors the status of the capsule and maintains communications with its occupant during the mission.

The ultimate manned orbital flights will be preceded by a series of suborbital (manned and unmanned) and orbital (unmanned) buildup flights to provide for:

a. Qualification of the Mercury capsule systems and structure;

b. Evaluation of all environmental conditions experienced in launch, powered flight, weightlessness, reentry, and landing;

c. Training and operational experience gained by the ground support systems and associated equipment.

GROUND MONITORING AND CONTROL

The Mercury Control Center at Cape Canaveral is the focal point of the entire operation. The primary functions of the Control Center are to:

a. Direct the entire flight in respect to the mission;

b. Monitor the flight in respect to aeromedical and capsule systems;

c. Keep the Astronaut and range stations informed of mission progress;

d. Coordinate all of the range stations and maintain a smooth flow of information to all of the units involved in the operation;

e. Supply information and alert the recovery forces following the decision to start reentry.

In particular, the Control Center is responsible for assessing proper insertion of the capsule into its specific orbit and, normally, for deciding whether to abort the mission during powered flight. A station in Bermuda acts mainly as an extension of the Canaveral Control Center and confirms that a proper insertion has been achieved. Bermuda may also be required to participate in the reentry operation in case an abort is commanded by the Control Center or communications between Canaveral and Bermuda are disrupted.

In addition to Cape Canaveral and Bermuda, there are 14 other network stations at various points along the orbital tracks around the earth (Figure 1). Twelve of these stations provide communications to the Astronaut and telemetry reception during the mission. The remaining two, located in the continental U.S., only provide tracking of the capsule during orbit and reentry. A central computing and communications center at the Goddard Space Flight Center, Beltsville, Maryland, provides the required orbital and reentry computing operations as well as the communications link between the remote stations and the Control Center.

These stations are manned by the following two groups.

a. Flight Controllers monitor the flight status of the capsule and overall conduct of the mission, and advise and assist the Astronaut in making decisions as required. The Flight Controllers prepare a summary report at the comple-

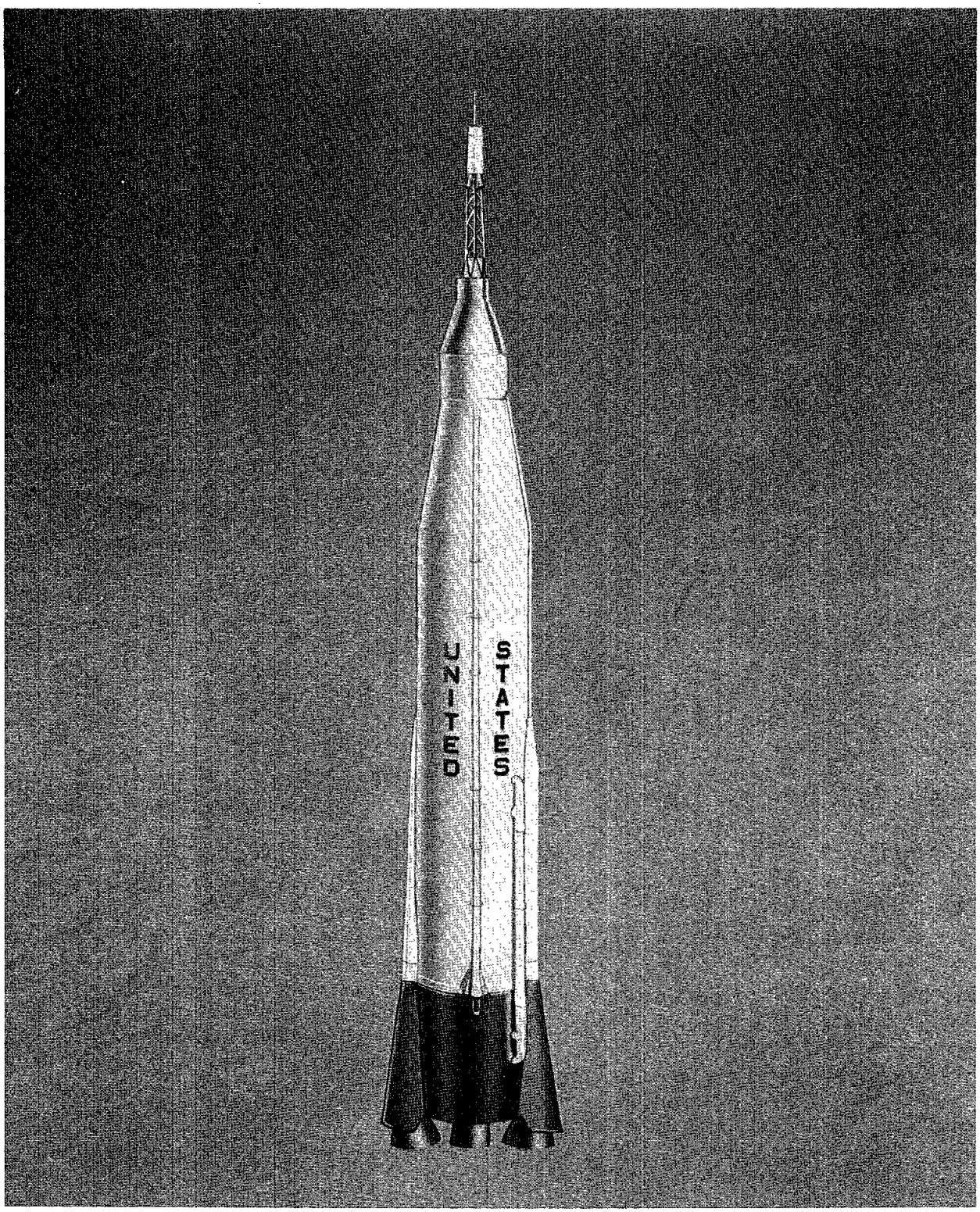


FIGURE 2. FLIGHT VEHICLE

tion of each pass for transmission to the Control Center.

b. Maintenance and operating personnel (M&O) provide technical support in the operation of the various tracking, telemetry, and communications systems.

The unmanned series of Mercury flights are monitored and controlled by ground command. The manned Mercury flights have the added capability of Astronaut command through his own actions or by request from the ground.

NORMAL MISSION DESCRIPTION

The launch vehicle which is shown with the Mercury capsule and escape tower in Figure 2, will place the capsule in orbit. The launch will be from one of the launch complexes at Cape Canaveral. The launch azimuth of the vehicle will be approximately north-northeast with the nominal insertion point between Canaveral and Bermuda at an altitude of approximately 100 miles.

The launch and insertion stages are shown in Figure 3; the reentry and recovery stages are shown in Figure 4; the mission sequence is illustrated in Figure 5. The escape tower remains with the capsule until approximately 15 seconds after staging (booster separation), then the tower is jettisoned. Once the proper velocity and angle for orbit have been achieved, the guidance system initiates sustainer engine cutoff and the capsule separation sequence is initiated. After five seconds, during which the capsule is in a damping mode, the automatic control system causes the capsule to rotate through 180° so that the blunt end (heat shield) faces in the direction of travel. In this attitude, the Astronaut travels backwards. At the same time, the blunt end is tilted upward to the reentry attitude to allow immediate reentry in case conditions at insertion are judged inadequate for at least one orbit or in case an emergency capsule or Astronaut condition exists. After five minutes the capsule is maneuvered to the normal orbital attitude of 14.5 degrees, which is required so that a device known as the horizon scanner has a full view of the horizon for navigation and observation.

During orbit, the Astronaut may, at his discretion, maneuver the capsule to any desired position. The capsule completes one, two, or three orbital cycles as determined from information obtained by the Astronaut and the ground monitors during orbital flight.

At the preselected time of retrofiring, which is the initiation of reentry from orbit, the capsule is maneuvered to the desired retrofiring angle and, at the precise time, the retrorockets are fired. The capsule is then maneuvered to the desired reentry attitude, and an attitude hold mode is initiated by the automatic control system. After a short delay, the retropackage is jettisoned. The capsule attitude is maintained until the capsule begins its atmospheric reentry, at which time the automatic control system reverts to a pure damping mode.

The descent continues to approximately 42,000 feet when a pressure-sensing device causes a drogue chute to be deployed to provide stabilization and deceleration. At 10,000 feet, a large parachute, 64 feet in diameter, is deployed and the capsule continues to descend at approximately 30 feet per second. (A backup parachute is provided in case of a malfunction of the main parachute.) At impact, the parachute is released, the various onboard systems are shut down, and the recovery aids activated.

Emergency Provisions

The capsule can be separated from the vehicle by an escape rocket system. If there is a malfunction of the launch vehicle or the capsule during the period from imminent launch through powered flight. The system consists of a pylon-mounted rocket configuration that is used up to just beyond staging. From that point up to sustainer cutoff, the separation is accomplished by posigrade (capsule base-mounted) rockets. Firing the rockets can be accomplished on command (1) from the ground, (2) by the Astronaut, or (3) by a special vehicle automatic abort sensing system.

Immediately after insertion, at the end of any complete pass, or even during orbit, a reentry could be commanded by the Astronaut or direct ground command from certain of the network sites.

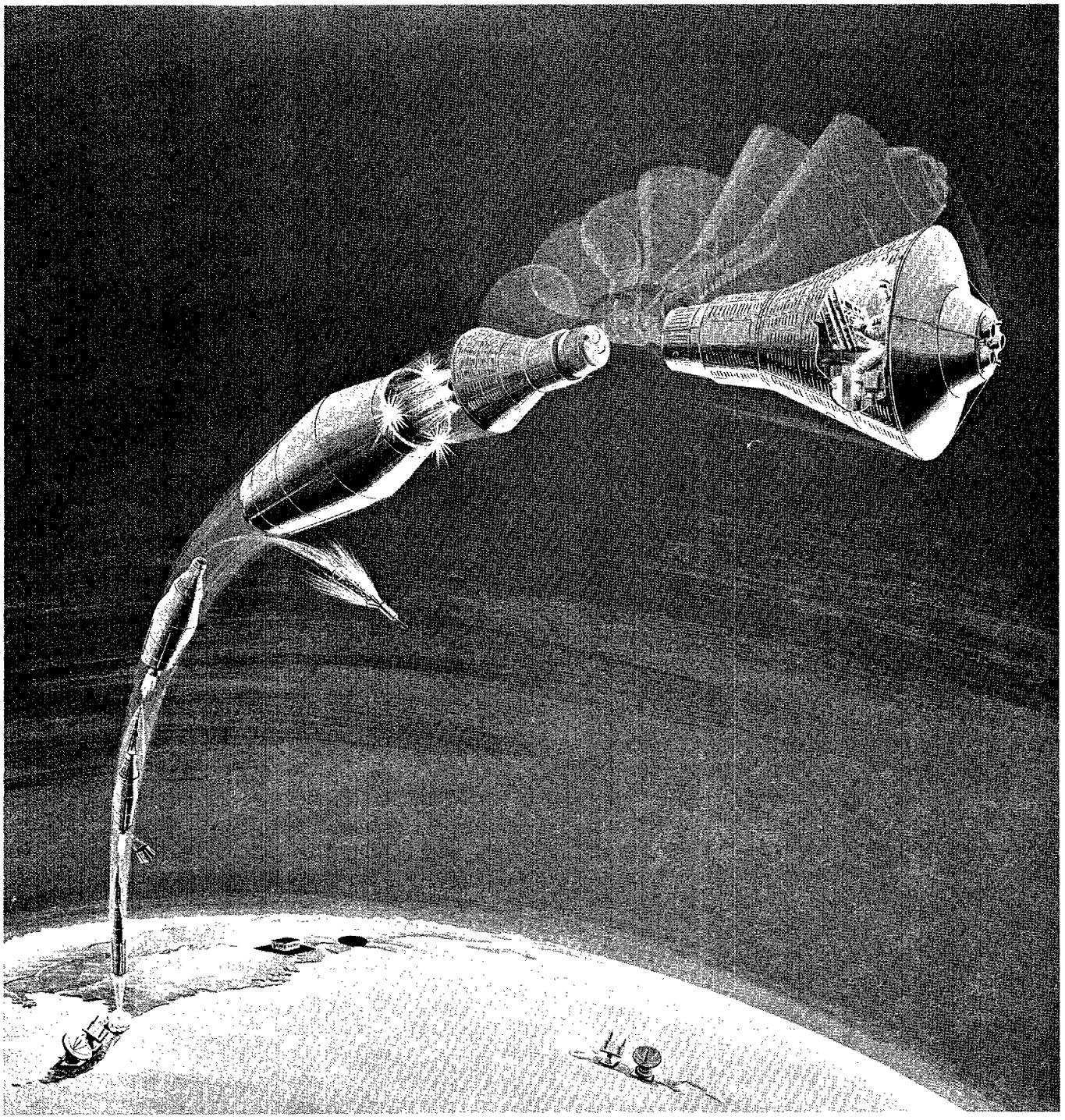


FIGURE 3. LAUNCH AND INSERTION STAGES

Recovery Provisions

A number of prime recovery areas (Figure 6) have been selected between Cape Canaveral and the West African coast to provide access to the capsule following a landing. If an abort occurs during any part of the powered flight (from liftoff through insertion), the capsule is expected to impact along the areas labeled A through A5. Areas B, C, and D will be used respectively if a reentry is commanded at the end of orbital pass. The recovery teams are provided with impact prediction data obtained from the network tracking and associated computing facilities, as well as the recovery aids in the capsule, to accomplish the recovery operation within a specified time. Although some definite plan for recovery from a reentry in other (contingency) areas will be arranged, every consideration will be made to avoid impact under those circumstances in view of the extreme recovery problems expected.

THE CAPSULE

Physical Description

The Mercury capsule (Figure 7) is basically a conical structure consisting of a blunt, dish-shaped forebody and an upper or afterbody. The forebody measures approximately 6 feet at its maximum diameter; the afterbody extends approximately 10 feet from the blunt face.

The forebody is a heat shield designed to protect the capsule from extreme thermal conditions during reentry flight. It is also designed to prevent capsule damage on landing impact. Attached to the heat shield are two sets of rocket assemblies. The posigrade set provides for capsule separation from the missile; the retrograde set produces a decrement in orbital velocity for reentry at the end of the mission.

The afterbody consists of a truncated, cone-shaped structure that contains the Astronaut's pressurized compartment. Above this is a 30-inch diameter cylindrical section containing the landing parachute, onboard recovery systems, and the main communications antenna.

The Astronaut rides strapped to a form-fitting couch in a fully pressurized suit. Oxygen is supplied directly to the suit, for breathing and ventilation, as well as to the cabin compartment. The equipment within the capsule interior is arranged so that all operating controls and manual overrides are accessible to the Astronaut. Cabin equipment basically consists of instrument and display panels, navigational aids, flight and abort control handles, food and water supply, waste containers, etc. Communications equipment will transmit technical data on the status of both the capsule and the Astronaut to the ground stations.

Communications System

Voice Communications

Communications in the capsule consist of:

a. Two ultra-high-frequency (UHF) transmitter/receivers;

b. One high-frequency (HF) (designated MAIN) transmitter/receiver;

c. One HF (designated RECOVERY) transmitter/receiver;

d. Transmission of Morse code by keying telemetry carrier;

e. Reception of voice through command receivers.

The Astronaut can operate any one voice transmitter at a time. However, simultaneously he can receive HF, UHF, and voice modulation on the command receiver in his headset. Each of these inputs has individual volume controls.

The primary voice system is UHF and employs amplitude modulation (AM). This system is available to the Astronaut from launch through recovery. He can select either of two UHF transmitter/receivers. They are indentical except that one transmitter, designated HIGH POWER (approximately two watts), employs an additional power amplifier to increase the output; the second transmitter, designated LOW POWER (approximately half a watt), uses the basic transmitter alone.

If adequate communications cannot be obtained with UHF, the Astronaut can select a secondary system, which is in the HF range. This system consists of a transmitter/receiver designated MAIN HF (five watts).

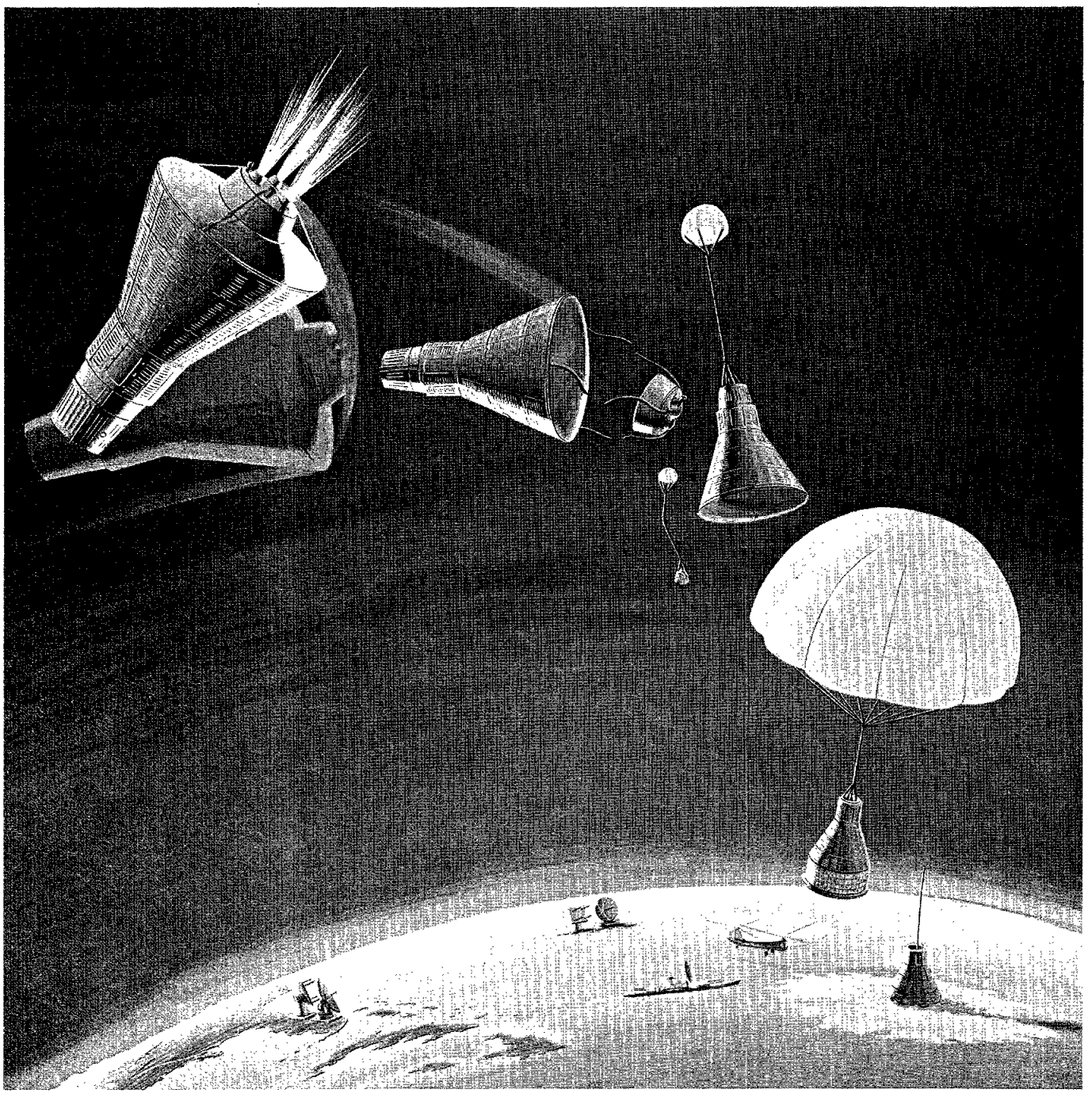


FIGURE 4. REENTRY AND RECOVERY STAGES

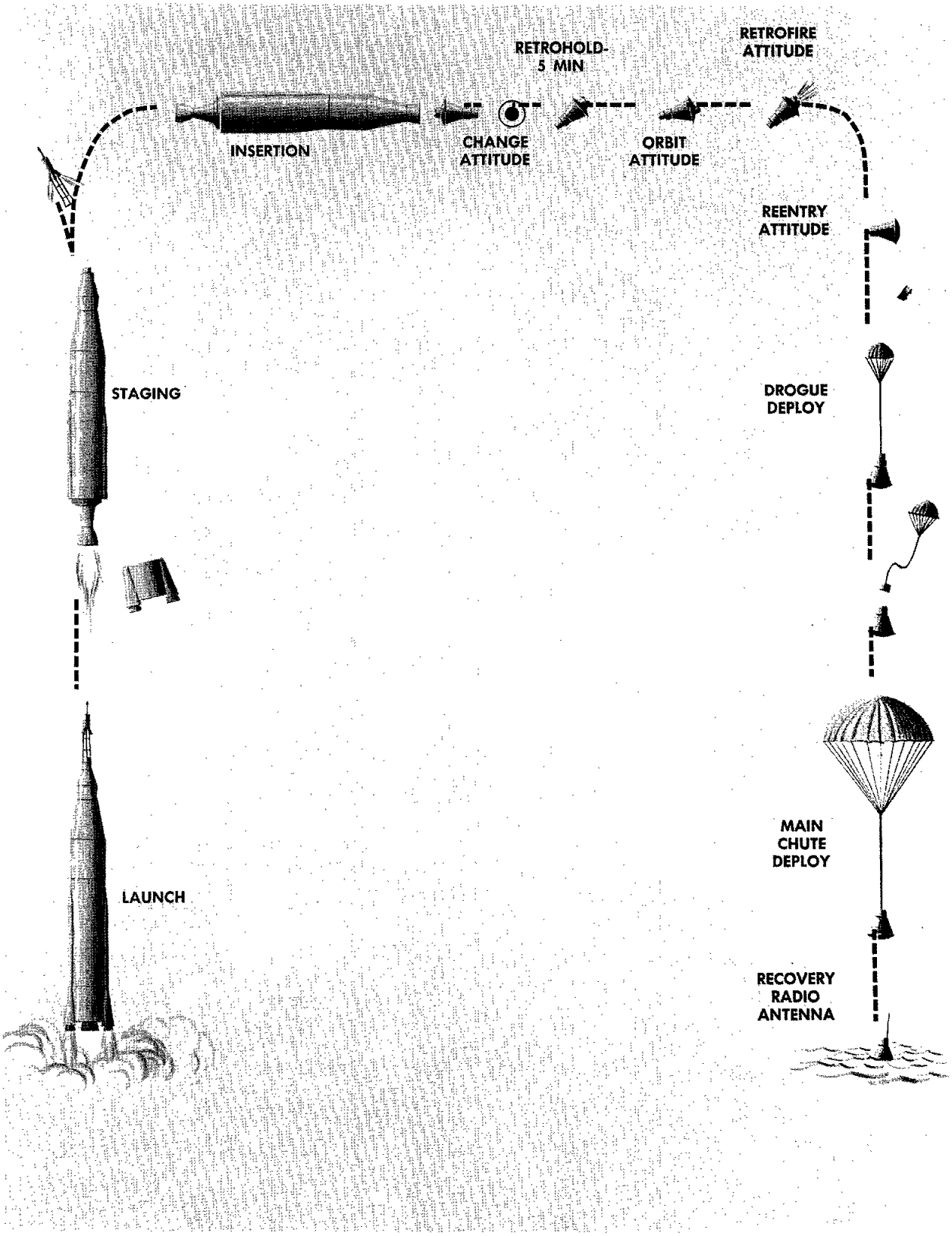


FIGURE 5. MISSION SEQUENCE

There is a problem of antenna dielectric breakdown whenever the capsule HF voice transmitter is operated between 200,000 and 300,000 feet. At these altitudes, the aerodynamic heating effects ionize the air. For this reason, the HF transmitters are not used until the capsule reaches approximately 400,000 feet. The MAIN HF is then available, as required, until reentry. During reentry, at approximately 10,000 feet when the antenna fairing is jettisoned to allow deployment of the parachutes, HF communication is lost. But after landing, an HF rescue antenna and transmitter-receiver (one watt) are activated.

Besides the voice systems, the Astronaut can key the low-frequency transmitter (designated TELEMETER CHANNEL A) by flipping a switch on the control panel. He can receive Morse code over the UHF and HF voice channels.

Command System

For reliability, there are two independent, simultaneously operating command systems. Each is a frequency modulated (FM) receiver that feeds a decoder section (tuned filters and relays), which in turn provides a number of command channels for various capsule control functions. Each command channel is activated by a subcarrier tone on the FM carrier. Separate power sources are provided for each unit and an emergency FM voice channel is also available.

Command functions, which may be initiated from the ground transmitters or by the Astronaut, are:

a. Abort;

b. Firing the retrorockets to initiate reentry;

c. Resetting the clock in the capsule.

In addition, a programer in the capsule will, on command from the ground, transmit over the telemetry channels, calibration voltages of zero and three volts for three seconds each. Also, for unmanned flights, the programer will transmit prerecorded tape messages, over the voice channels, for communications evaluation.

Telemetry System

Two separate FM/FM telemetry systems, designated A and B, transmit simultaneously for increased reliability. The systems conform essentially to Inter-Range Instrumentation Group (IRIG) standards, differing only in modulation index and in commutator format. Four channels are used for the Mercury mission. Channels 5, 6, and 7 continuously transmit heart and respiration data. Channel 12, using PAM/FM/FM (PAM indicates pulse amplitude modulation), transmits other aeromedical, environmental, systems status, and events data. A total of approximately 70 commutated channels are used. Both telemetry transmitters transmit the same quantities for real-time display purposes; however, a few of the other transmitted quantities being recorded on the ground are different on the two systems. Telemetry transmitter A can be keyed by the Astronaut, which will result in an interrupted signal or negative keying.

Beacons

Beacons are provided to permit tracking by ground stations. An S-band beacon is provided for cooperative use by the ground Verlort radar and a C-band beacon is provided for use with the FPS-16 radar.

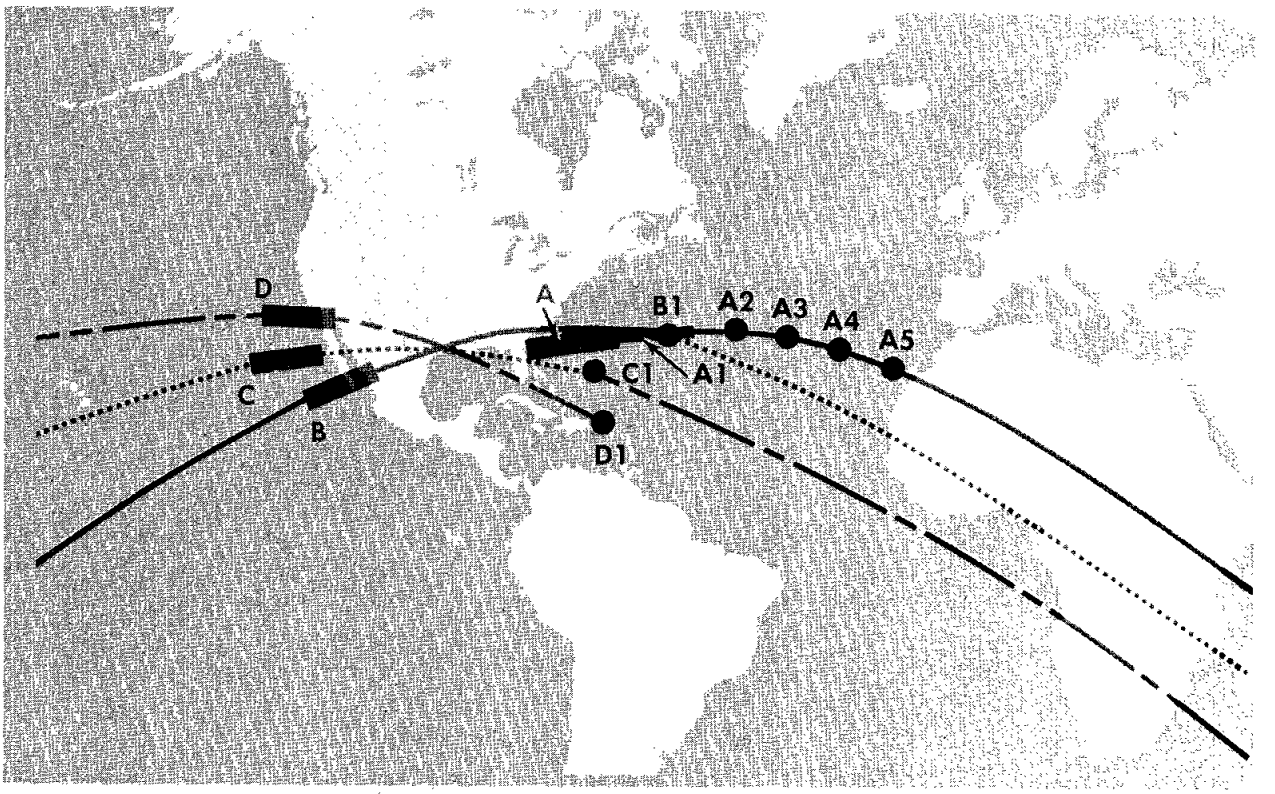
Both the C- and S-band radar beacons have receivers for accepting interrogation pulses from the appropriate tracking radar. To avoid response to unintentional radar signals, a double-pulse code may be used. After a short delay, the beacon transmitters actively respond with a pulse to the interrogating radar.

A recovery beacon that contains both HF and UHF portions is also provided. The HF operates on the international distress signal. The UHF is a Search and Range and Homing (SARAH) type of double-pulse homing beacon operating on the international rescue frequency.

Audio System and Control Panel

The audio center provides audio mixing, filtering, and amplification for the microphones and earphones, and includes a voice-operated relay circuitry for transmitter keying.

The control panel contains volume controls for three voice reception channels, the emergency telemetry key switch, and the direction-finding voice communications selector switch.



LEGEND

A, A5	ABORT AT INSERTION	▬	RETROFIRING POINT
B, B1	FIRST PASS AND CERTAIN LAUNCH ABORTS	●	RECOVERY AREA
		———	1st ORBIT
C, C1	SECOND PASS	·····	2nd ORBIT
D, D1	THIRD PASS	— — —	3rd ORBIT

FIGURE 6. PRIME RECOVERY AREAS

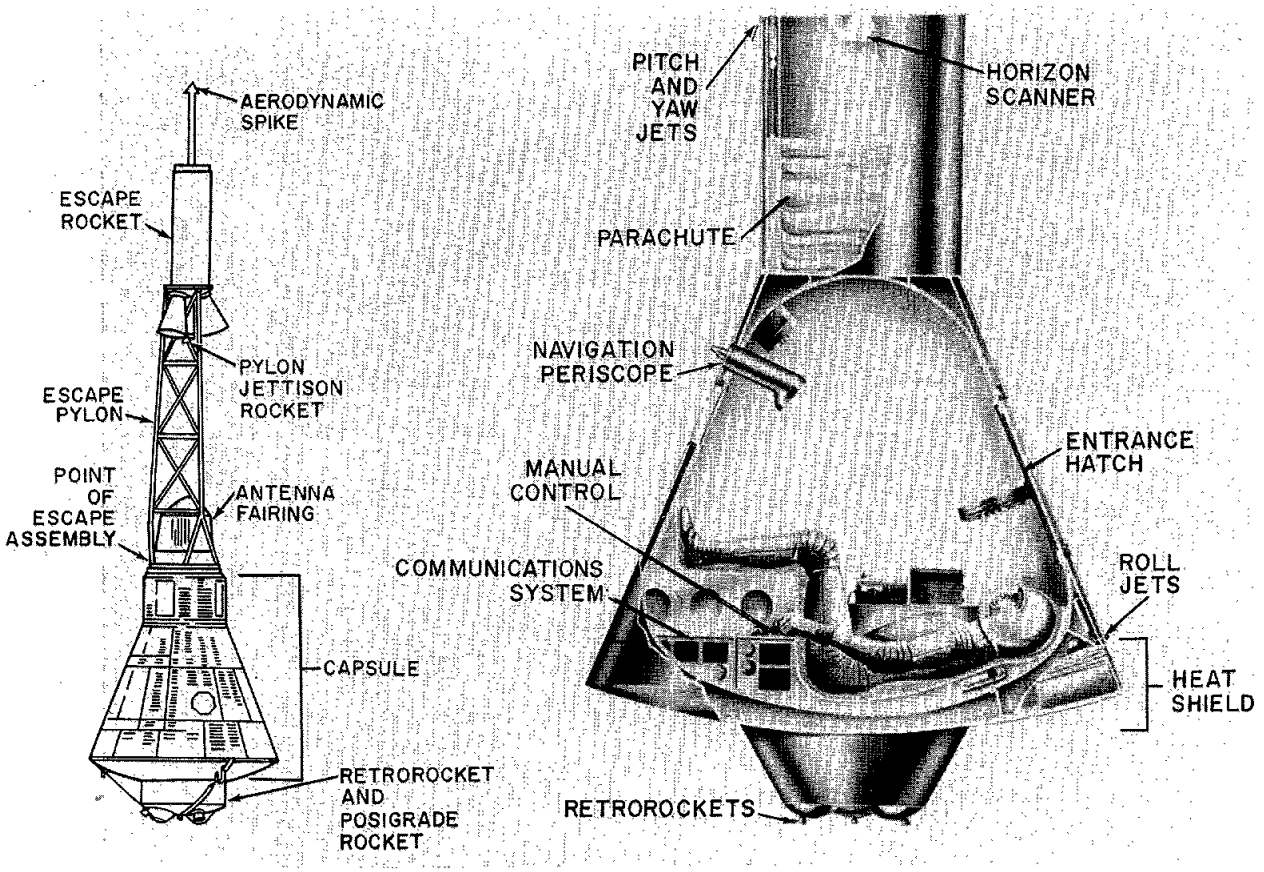


FIGURE 7. THE CAPSULE

Antennas.—All communications systems except the radar beacons are multiplexed to a single antenna, which is formed by electrically insulating two portions of the capsule. The resulting structure resembles an antenna consisting of a disk attached to the vertex of a cone. This is commonly known as a discone antenna.

During reentry, at 10,000 feet, the main antenna is released and a fan monopole descent antenna erects. The UHF voice, telemetry, and command systems are multiplexed to this antenna.

Immediately after landing, an antenna is raised to which the HF rescue and the HF portion of the recovery beacon are duplexed.

Radar beacon antennas, three for each band, are situated around the upper conical section at 120-degree intervals to provide circular polarization.

Other Capsule Systems

Other systems include:

a. Environmental control system;

b. Stabilizing control system;

c. Sequencing system for various capsule events;

d. Rocket systems for escape, separation, and reentry.

Telemetry data and voice communications, which are recorded onboard the capsule, are the basic real-time information link between the Astronaut and the ground stations, for flight monitoring and control.

The ground tracking and instrumentation system consists of 16 ground stations in addition to the Goddard Space Flight Center. Five of of the stations are located on existing ranges. There is one additional station in the continental United States. Two of the stations are on shipboard and the eight remaining stations are on foreign territory.

PERSONNEL ASSIGNMENTS

A basic operational organization has been established to control and coordinate efficiently all activities contributing to the Mercury mission.

At the Mercury Control Center at Cape Canaveral, key positions have been assigned to carry out the specific duties associated with the mission. These positions are: Operations Director, Network Commander, Recovery Task Force Commander, Flight Director, Network Status Monitor, Recovery Status Monitor, Flight Dynamics Officer, Retrofire Controller, Capsule Systems Monitor, Capsule, Communicator, Flight Surgeon, Vehicle Telemetry Monitor, Range Safety Observer, and Capsule Environment Monitor.

The countdown and prelaunch operations will be coordinated at the Cape Canaveral Blockhouse. Until liftoff, this staff will be in close communication with the staff at the Control Center.

The staff at Bermuda has responsibilities similar to those at the Control Center. Personnel consist of: Flight Supervisor, Flight Surgeon, Capsule Environment Monitor, Capsule Systems Monitor, Flight Dynamics Officer, and Capsule Communicator.

The Flight Monitoring Staff (Flight Controllers) at remote stations include: Capsule Communicator, Aeromedical Monitor, and Capsule Systems Monitor.

The M&O Chief at each remote site (called the Support Control Coordinator at Cape Canaveral) coordinates technical activities concerned with maintenance and operation of the ground support systems. He acts as liaison between the Flight Controllers and M&O personnel and keeps the Flight Controllers informed about any equipment irregularities that may affect flight control.

The Communications Coordinator at each station coordinates and is responsible for all incoming and outgoing range message traffic, both teletype and voice, where available. During a mission operation, he is integrated into procedural activities to offer maximum communications support to the control personnel.

An M&O team is assigned to each ground support system at each site. Each team is responsible for the proper operation of the system to which it is assigned and for providing Flight Controllers with the best available source of data.

SITE HANDBOOK

SITE HANDBOOK

FOREWORD

The Site Handbook contains information on the functions, equipment, facilities, and environment of the sites. Functional block diagrams, simplified schematics, charts, and maps show the interrelationship and locations of the systems at each site, as well as its administrative organization. Sites that have the same or nearly similar system configurations are combined into a single section.

TABLE OF CONTENTS

Section	*Title*
1	INTRODUCTION
2	CAPE CANAVERAL
3	GRAND BAHAMA AND GRAND TURK ISLANDS
4	BERMUDA
5	ATLANTIC AND INDIAN OCEAN SHIPS
6	GRAND CANARY ISLAND, MUCHEA, WOOMERA, GUAYMAS, AND CORPUS CHRISTI
7	KAUAI
8	POINT ARGUELLO
9	WHITE SANDS AND EGLIN
10	CANTON ISLAND, KANO, AND ZANZIBAR
	LIST OF ABBREVIATIONS

LIST OF ILLUSTRATIONS

Figure	*Title*	*Page*
Front.	Composite Mercury Site with Complete Instrumentation	1-ii
1-1	Site Functions	1-iv
1-2	Typical Intercommunications Network	1-3
1-3	Intersite Ground Communications	1-4
1-4	Passport, Visa, Immunization, and Photograph Requirements	1-6
2-1	Master Functional Block Diagram—Cape Canaveral	2-17/18
2-2	Simplified Intercommunication System—Cape Canaveral	2-19
2-3	Site Intercommunications Flow Chart—Cape Canaveral	2-21
2-4	Radar Data Processing—Cape Canaveral	2-23
2-5	Site Location—Cape Canaveral	2-24
2-6	Floor Plan, TEL-3 Building—Cape Canaveral	2-25
2-7	Site Administration—Cape Canaveral	2-27
3-1	Master Functional Block Diagram—Grand Bahama Island	3-7
3-2	Master Functional Block Diagram—Grand Turk Island	3-8
3-3	Transmit and Receive Antenna System—Grand Bahama Island and Grand Turk Island	3-9
3-4	Functional Block Diagram, Acquisition Aid Equipment — Grand Bahama Island and Grand Turk Island	3-11
3-5	Functional Block Diagram, Telemetry System — Grand Bahama Island and Grand Turk Island	3-13
3-6	Functional Block Diagram, Air-Ground Communications—Grand Bahama Island and Grand Turk Island	3-14
3-7	Area Map — Grand Bahama Islands	3-15
3-8	Area Map — Grand Bahama Island	3-16
3-9	Transmitter Site — Grand Bahama Island	3-17
3-10	Receiver Building—Grand Bahama Island	3-18
3-11	Floor Plan, Telemetry Area—Grand Bahama Island	3-19
3-12	Floor Plan, Transmitter Area—Grand Bahama Island	3-20
3-13	Area Map—Grand Turk Island	3-21
3-14	Transmitter Area—Grand Turk Island	3-22
3-15	Receiver Area—Grand Turk Island	3-23
3-16	Floor Plan, Telemetry Area—Grand Turk Island	3-24
3-17	Floor Plan, Transmitter Area—Grand Turk Island	3-25
3-18	Site Administration—Grand Bahama Island and Grand Turk Island	3-27
4-1	Master Functional Block Diagram—Bermuda	4-9
4-2	Site Equipment Block Diagram, Intrasite Intercommunication System—Bermuda	4-10
4-3	Functional Block Diagram, Timing System—Bermuda	4-11
4-4	Functional Block Diagram, Acquisition System—Bermuda	4-12
4-5	Functional Block Diagram, Telemetry System—Bermuda	4-13/14

LIST OF ILLUSTRATIONS (Continued)

Figure	*Title*	*Page*
4-6	Functional Block Diagram, Transmitting and Receiving Antennas—Bermuda	4-15
4-7	Functional Block Diagram, Air-Ground Communications—Bermuda	4-16/17
4-8	Functional Block Diagram, Radar Data and Teletype—Bermuda	4-18
4-9	Floor Plan, Verlort Radar Van —Bermuda	4-19
4-10	Functional Block Diagram, Ground Radio and Teletypewriter—Bermuda	4-21
4-11	Block Diagram, Command Transmitter Equipment — Bermuda	4-23
4-12	Functional Block Diagram, Display Equipment—Bermuda	4-25
4-13	Functional Block Diagram, Computer—Bermuda	4-26
4-14	Area Map—Bermuda	4-27
4-15	Floor Plan, Telemetry and Control Building—Coopers Island	4-28
4-16	Floor Plan, FPS-16 Building—Coopers Island	4-29
4-17	Floor Plan, Receiver Building —Town Hill	4-31
4-18	Site Administration—Bermuda	4-32
5-1	Master Functional Block Diagram—Atlantic Ship and Indian Ocean Ship	5-9
5-2	Functional Block Diagram, Intrasite Intercommunications System—Atlantic Ship and Indian Ocean Ship	5-10
5-3	Functional Block Diagram, Timing System—Atlantic Ship and Indian Ocean Ship	5-11
5-4	Functional Block Diagram, Acquisition System—Atlantic Ship and Indian Ocean Ship	5-12
5-5	Functional Block Diagram, Antenna System — Atlantic Ship and Indian Ocean Ship	5-13
5-6	Functional Block Diagram, Telemetry System—Atlantic Ship and Indian Ocean Ship	5-14
5-7	Functional Block Diagram, Air-Ground Communications—Atlantic Ship and Indian Ocean Ship	5-15
5-8	Area Map—Atlantic Ship and Indian Ocean Ship	5-17
5-9	Antenna and Equipment Placement—Atlantic Ship and Indian Ocean Ship	5-19
5-10	Telemetry Room — Atlantic Ship and Indian Ocean Ship	5-20
5-11	Transmitter Equipment Area—Atlantic Ship and Indian Ocean Ship	5-21
5-12	Site Administration — Atlantic Ship and Indian Ocean Ship	5-22
6-1	Master Functional Block Diagram—Muchea and Guaymas	6-15
6-2	Master Functional Block Diagram—Grand Canary Island	6-16
6-3	Master Functional Block Diagram—Woomera, Australia	6-17
6-4	Master Functional Block Diagram—Corpus Christi, Texas	6-18
6-5	Ground Communications, Teletypewriter Line-Sharing Layout	6-19
6-6	Block Diagram, Typical Timing System	6-21
6-7	Block Diagram, Acquisition System	6-22

LIST OF ILLUSTRATIONS (Continued)

Figure	*Title*	*Page*
6-8	Functional Block Diagram, Telemetry System—Grand Canary Island, Woomera and Corpus Christi	6-23
6-9	Functional Block Diagram, Telemetry System — Muchea and Guaymas	6-24
6-10	Air-Ground Communications Facilities—Grand Canary Island	6-25
6-11	Air-Ground Communications Facilities—Muchea	6-26
6-12	Air-Ground Communications Facilities—Woomera and Corpus Christi	6-27
6-13	Air-Ground Communications Facilities—Guaymas	6-28
6-14	Functional Block Diagram, Radar System — Grand Canary Island	6-29
6-15	Functional Block Diagram, Radar System—Muchea, Guaymas and Corpus Christi	6-30
6-16	Functional Block Diagram, Radar System—Woomera	6-31
6-17	Area Map — Grand Canary Island	6-33
6-18	Site Plan—Grand Canary Island	6-34
6-19	Floor Plan—Grand Canary Island	6-35
6-20	Verlort Radar Van—Grand Canary Island, Guaymas, Kauai, and Corpus Christi, Texas	6-36
6-21	Area Map—Muchea and Woomera	6-37
6-22	Site Plan—Muchea	6-38
6-23	Floor Plan, Telemetry and Control Area—Muchea	6-39
6-24	Transmitter Van—Muchea and Guaymas	6-40
6-25	Site Plan—Woomera, Australia	6-41
6-26	Floor Plan, Telemetry and Control Area—Woomera	6-42
6-27	Transmitter Van — Grand Canary Island, Woomera, Point Arguello, and Corpus Christi	6-43
6-28	Area Map—Guaymas	6-44
6-29	Site Plan—Guaymas	6-45
6-30	Floor Plan, Telemetry and Control Area—Guaymas	6-46
6-31	Area Map—Corpus Christi	6-47
6-32	Rodd Field, Showing Mercury Areas	6-48
6-33	Telemetry and Control Area—Corpus Christi	6-49
6-34	Site Administration	6-50
7-1	Master Functional Block Diagram—Hawaii	7-9
7-2	Functional Block Diagram, Acquisition System—Hawaii	7-10
7-3	Functional Block Diagram, Air-Ground Communications — Hawaii	7-11/12
7-4	Transmitter Van—Hawaii; Zanzibar; Canton Island; Kano, Nigeria	7-13
7-5	Floor Plan, UHF Command Transmitter Vans—Hawaii	7-15
7-6	Functional Block Diagram, Antenna System—Hawaii	7-16
7-7	Functional Block Diagram, Radar System—Hawaii	7-17
7-8	Command Transmitter System —Hawaii	7-19
7-9	Area Map—Hawaii	7-20
7-10	Project Mercury—Hawaii	7-21

LIST OF ILLUSTRATIONS (Continued)

Figure	Title	Page
7-11	Location Map—Hawaii	7-22
7-12	Site Plan, S-band Radar Area—Hawaii	7-23
7-13	Site Plan, Telemetry and Control Area—Hawaii	7-24
7-14	Floor Plan, Telemetry and Control Area—Hawaii	7-25
7-15	Site Administration—Hawaii	7-26
8-1	Master Functional Block Diagram—Point Arguello	8-9
8-2	Functional Block Diagram, Timing System—Point Arguello	8-10
8-3	Functional Block Diagram, Acquisition System—Point Arguello	8-11
8-4	Functional Block Diagram, Telemetry System — Point Arguello	8-12/13
8-5	Functional Block Diagram, Capsule Communications System—Point Arguello	8-14/15
8-6	Functional Block Diagram, Radar System—Point Arguello	8-16
8-7	Capsule Command Transmitter System—Point Arguello	8-17
8-8	Area Map—Point Arguello	8-18
8-9	Site Location—Point Arguello	8-19
8-10	Transmitter Building — Point Arguello	8-20
8-11	Floor Plan, UHF Command Transmitter Vans—Point Arguello	8-21
8-12	Room 224, Range Operations Building—Point Arguello	8-23
8-13	LA-24 Building, Acquisition Aid Equipment—Point Arguello	8-24
8-14	Equipment Location, Range Operations Building — Point Arguello	8-25
8-15	Equipment Location, Telemetry Building—Point Arguello	8-26
8-16	Verlort Radar Van—Point Arguello	8-27
8-17	Site Administration—Point Arguello	8-28
9-1	Master Functional Block Diagram—White Sands	9-7
9-2	Master Functional Block Diagram—Eglin	9-8
9-3	Functional Block Diagram, Timing System — White Sands and Eglin	9-9
9-4	Functional Block Diagram, Acquisition System—White Sands	9-11
9-5	Functional Block Diagram, Acquisition System—Eglin	9-13
9-6	Functional Block Diagram, Radar System—White Sands	9-14
9-7	Functional Block Diagram, Radar System—Eglin	9-15
9-8	Area Map—White Sands	9-17
9-9	Equipment Location — White Sands	9-18
9-10	Area Map—Eglin	9-19
9-11	Equipment Location—Eglin	9-20
9-12	Site Administration — White Sands and Eglin	9-21
10-1	Master Functional Block Diagram—Canton Island	10-11
10-2	Master Functional Block Diagram—Kano, Nigeria	10-12
10-3	Master Functional Block Diagram—Zanzibar	10-13
10-4	Intercommunication Functional Block Diagram—Canton Island	10-14

LIST OF ILLUSTRATIONS (Continued)

Figure	*Title*	*Page*
10-5	Intercommunication Functional Block Diagram—Kano, Nigeria, and Zanzibar	10-15
10-6	Functional Block Diagram, Acquisition System — Canton Island; Kano, Nigeria; Zanzibar	10-16
10-7	Functional Block Diagram, Antenna Systems—Canton Island; Kano, Nigeria; Zanzibar	10-17
10-8	Functional Block Diagram, Telemetry System—Canton Island; Kano, Nigeria; Zanzibar	10-18
10-9	Functional Block Diagram, Air-Ground Communications — Canton Island; Kano, Nigeria; Zanzibar	10-19
10-10	Location, Project Mercury Components—Canton Island	10-21
10-11	Area Locations—Canton Island	10-22
10-12	Floor Plan, Telemetry and Control Area—Canton Island	10-23
10-13	Floor Plan, Transmitter Van	10-24
10-14	Site Location—Kano, Nigeria	10-25
10-15	Area Location—Kano, Nigeria	10-26
10-16	Receiver Installation — Kano, Nigeria	10-27
10-17	Transmitter Area — Kano, Nigeria	10-28
10-18	Floor Plan, Telemetry and Control Area—Kano, Nigeria, and Zanzibar	10-29
10-19	Site Location—Zanzibar	10-30
10-20	Tunguu Receiver Site — Zanzibar	10-31
10-21	Chwaka Transmitter Site—Zanzibar	10-32
10-22	Site Administration—Kano, Nigeria, and Zanzibar	10-33
10-23	Site Administration—Canton Island	10-34

LIST OF TABLES

Table	*Title*	*Page*
1-1	Master Functional Block Diagram Numbering System	1-5
1-2	Subsystems Functional Block Diagram Numbering System	1-5
2-1	Communication Circuits Required of Existing Site Facilities	2-3
2-2	Equipment and Services Supplied by Existing Facilities	2-10
2-3	Equipment Not Supplied by Existing Facilities (Major Items)	2-12
3-1	Major Equipments—Grand Bahama Island and Grand Turk Island	3-3
4-1	Equipment Allocations — Bermuda	4-5
5-1	Equipment Allocations—Atlantic and Indian Ocean Ships	5-5
6-1	Equipment Allocations—Grand Canary Island; Muchea, Australia; Woomera, Australia; Guaymas, Mexico; Corpus Christi, Texas	6-6
7-1	Equipment Allocations—Kauai, Hawaii	7-6
8-1	Equipment Allocation — Point Arguello	8-6
9-1	Equipment Allocations—White Sands, New Mexico, and Eglin, Florida	9-3
10-1	Equipment Allocations—Zanzibar; Canton Island; Kano, Nigeria	10-5

Section 1

INTRODUCTION

TABLE OF CONTENTS

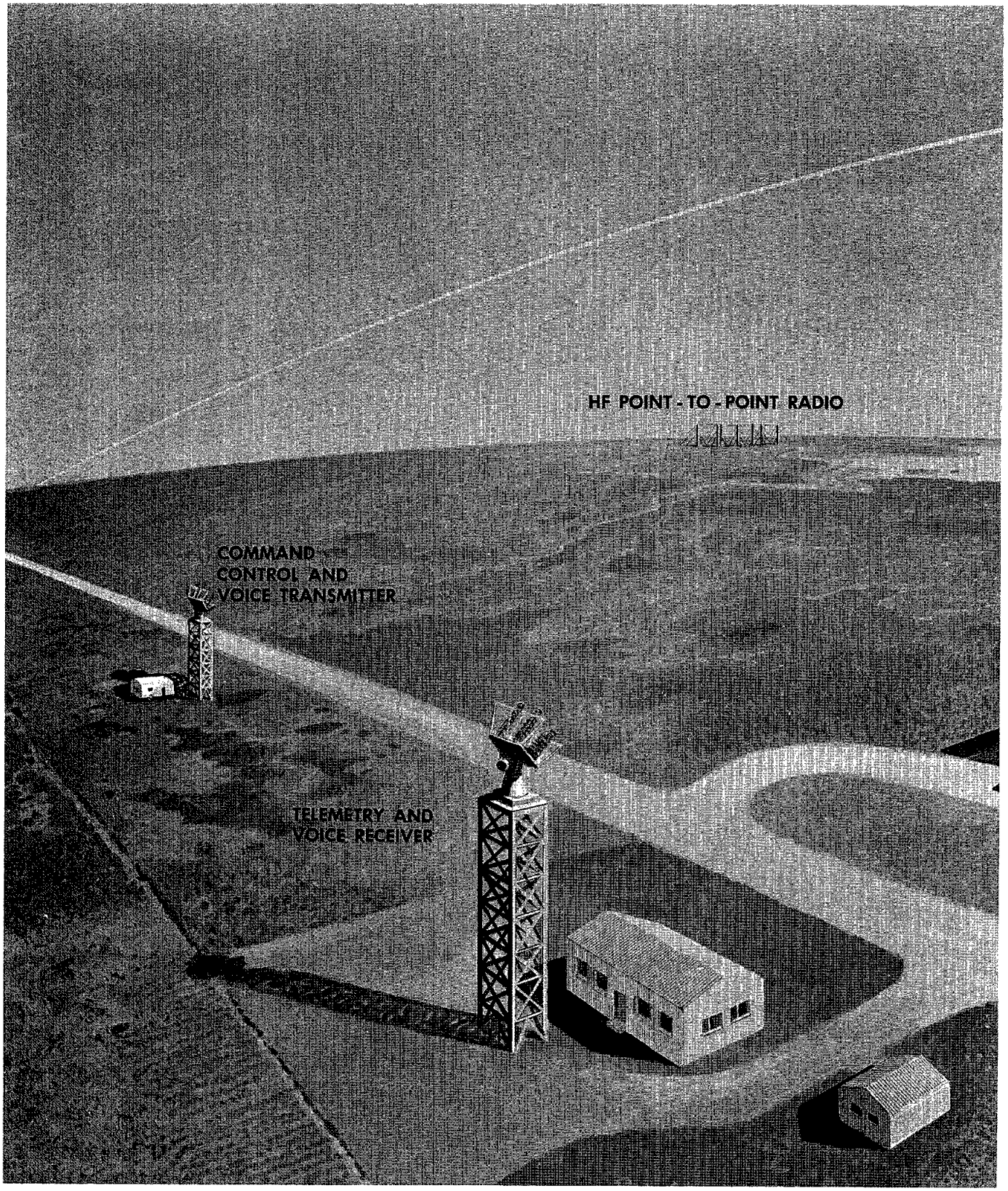
Paragraph	*Title*	*Page*
1.1	Purpose of the Site	1-1
	Ground Communications System	1-1
	Timing System	1-1
	Acquisition System	1-1
	Telemetry System	1-1
	Capsule Communications System	1-1
	Radar System	1-1
	Command Control System	1-1
	Computer System	1-1
1.2	Systems	1-1
1.3	Illustrations	1-1
1.4	Equipment Allocations	1-2
1.5	Site Administration	1-5
1.6	Geographic and Climatic Data	1-5
1.7	Transportation and Communications	1-5
1.8	Site Personnel Facilities and Services (Housing, Medical Facilities, Recreational Facilities, Mail Service, Religious Facilities, Clothing, and Food)	1-5
1.9	Miscellaneous Information (Money, Taxes, Passport, Visa, Immunization, and Photograph Requirements)	1-6

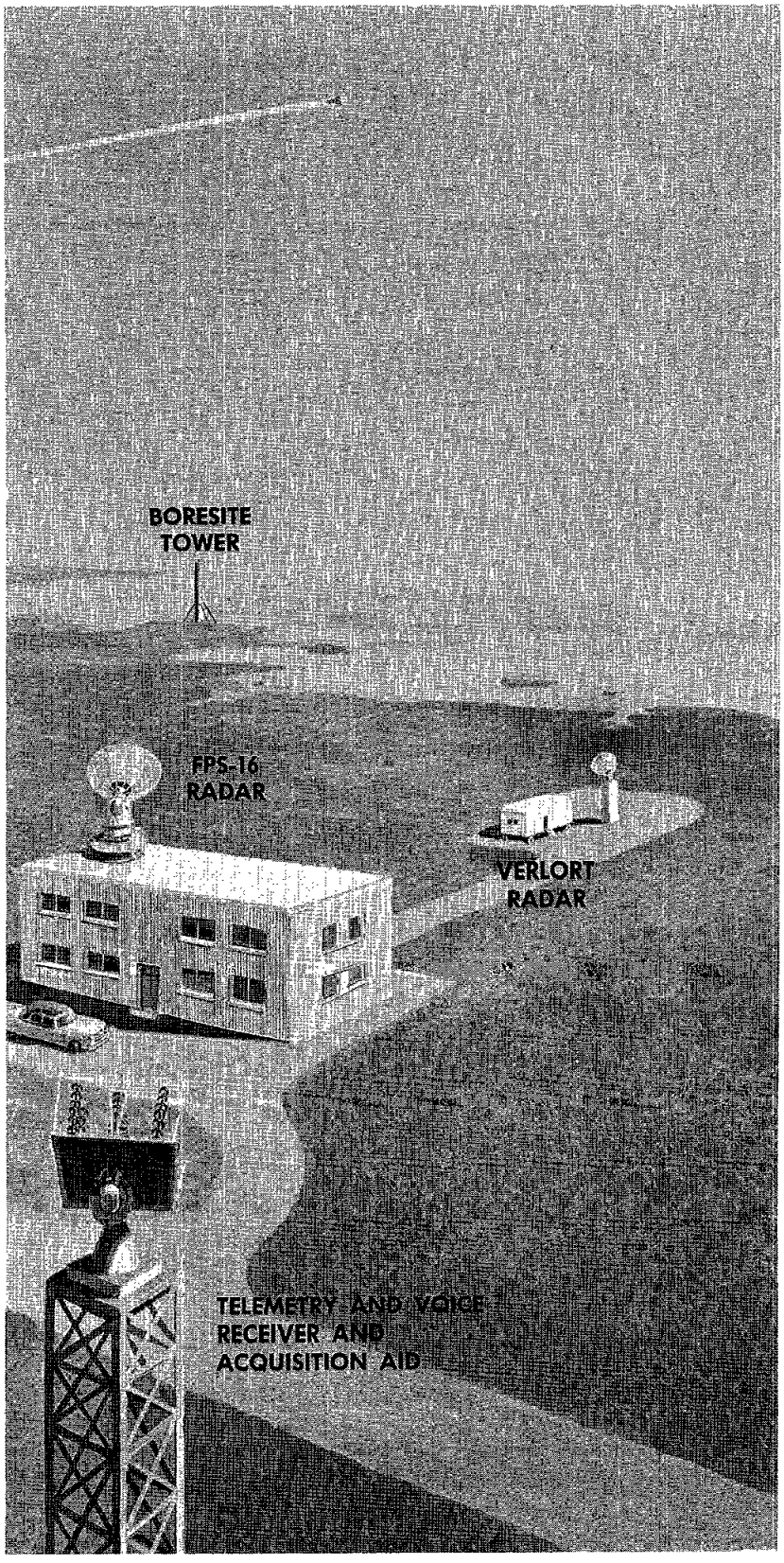
LIST OF ILLUSTRATIONS

Figure	*Title*	*Page*
Front.	Composite Mercury Site with Complete Instrumentation	1-ii
1-1	Site Functions	1-iv
1-2	Typical Intercommunications Network	1-3
1-3	Intersite Ground Communications	1-4
1-4	Passport, Visa, Immunization, and Photograph Requirements	1-6

LIST OF TABLES

Table	*Title*	*Page*
1-1	Master Functional Block Diagram Numbering System	1-2
1-2	Subsystems Functional Block Diagram Numbering System	1-5


HF POINT - TO - POINT RADIO
COMMAND CONTROL AND VOICE TRANSMITTER
TELEMETRY AND VOICE RECEIVER



COMPOSITE MERCURY SITE WITH COMPLETE INSTRUMENTATION

STA ABB	STA NO.	NAME	COVERAGE PASSES	RADAR		TELEMETRY RECEPTION	COMMUNI-CATION (CAPSULE)	COMMAND CONTROL	ACQUISI-TION			GROUND COMM			TIMING
				S	C				FA	SA	M	VOICE	TTY	SSB RADIO	
CNV	1A	CANAVERAL	1, 2, & 3	(X)	X	X	X	X	X	(X)		X	X		X
GBI	1B	GRAND BAHAMA	1, 2, & 3		(X)	X	X				X	X	X		AMR
GTI	1C	GRAND TURK	1, 2, & 3			X	X				X	X	X		AMR
BDA	2	BERMUDA	1, 2, & 3	X	X	X	X	X	X			X	X		X
ATS	3	ATLANTIC SHIP	1, 2, & 3			X	X		X				X	X	X
CYI	4	GRAND CANARY ISLAND	1 & 2	X		X	X		X				X	X	X
KNO	5	KANO, NIGERIA	1 & 2			X	X			X			X	X	X
ZZB	6	ZANZIBAR	1 & 2			X	X			X			X	X	X
IOS	7	INDIAN OCEAN SHIP	1, 2, & 3			X	X		X				X	X	X
MUC	8	MUCHEA, AUSTRALIA	1, 2, & 3	X		X	X	X	X			X	X	X	X
WOM	9	WOOMERA, AUSTRALIA	1 & 2		X	X	X		X			X	X		X
CTN	11	CANTON ISLAND	1 & 2			X	X			X			X		X
HAW	12	KAUAI ISLAND, HAWAII	2 & 3	X	X	X	X	X	X			X	X		X
CAL	13	PT. ARGUELLO, CALIFORNIA	2 & 3	X	X	X	X	X	X			X	X		X
GYM	14	GUAYMAS, MEXICO	1, 2, & 3	X		X	X	X	X			X	X		X
WHS	15	WHITE SANDS, NEW MEXICO	1, 2, & 3		X				X			X	X		X
TEX	16	CORPUS CHRISTI, TEXAS	1, 2, & 3	X		X	X		X			X	X		X
EGL	17	EGLIN, FLORIDA	1, 2, & 3	*	X				X			X	X		X
		GODDARD SFC		GROUND COMMUNICATIONS											X

SITE FUNCTIONS: FA = FULLY AUTOMATIC SA = SEMI AUTOMATIC M = MANUAL SSB = SINGLE SIDE BAND

*MPQ-31

FIGURE 1-1. SITE FUNCTIONS

SECTION 1. INTRODUCTION

1.1 PURPOSE OF THE SITE

Sites are classified as to common purposes according to their systems, listed in Figure 1-1. Additional unique purposes are noted in the section of this handbook pertaining to the site. The Mercury systems, with a definition of their purposes at a site, are given in the following paragraphs.

1.1.1 Ground Communications System

Sites are required to forward their data to the Mercury Control Center at Cape Canaveral and to the computing and communications center (Goddard Space Flight Center) at Beltsville, Maryland, for evaluation and processing. They must also be able to receive information and instructions from the Control Center. In addition, each site must have an effective intercommunications system (Figure 1-2). Diagrams for Cape Canaveral and Bermuda are shown in the sections describing these sites. In addition, some sites may relay information for other sites. This function is discussed in the section describing the individual sites where it applies. Overall ground intersite communications are shown in Figure 1-3.

1.1.2 Timing System

This system relates all information obtained at a site to a common time base that is applicable to all sites.

1.1.3 Acquisition System

This system acquires signals from the capsule for the various associated site systems. It causes various steerable antennas at the site to be pointed at the capsule.

1.1.4 Telemetry System

This system monitors the capsule environmental conditions and the physical condition of the occupant. This is accomplished by signals transmitted from the capsule and received by the system.

1.1.5 Capsule Communications System

This system provides two-way communications with the capsule.

1.1.6 Radar System

Radar tracks the capsule. A radar supplies information on slant range and on azimuth and elevation angles of the capsule with respect to the radar. This can be converted to absolute height, ground plane distance, and velocity or speed of the capsule.

1.1.7 Command Control System

A very important purpose of sites having this system is the control of programmed events within the capsule. This includes actuating normal reentry of the capsule or aborting the capsule flight on an emergency basis.

1.1.8 Computer System

Sites equipped with computers rapidly supply information about the flight. Evaluation of input data can verify the actual versus the predicted flight path, predict the coordinates and the time at which the capsule will be contacted (or acquired) by the sites, and predict the point of impact of the capsule on its reentry into the atmosphere at the end of a flight.

1.2 SYSTEMS

These are described with particular emphasis on site equipment locations, backup provisions in case of failures, and unique circuit configurations at a site. Technical language is minimized to present a more informal functional description of the systems than the systems manuals or equipment manuals, which contain detailed information.

1.3 ILLUSTRATIONS

Drawings of the sites show the general area in which the site is located, the specific location of the systems on the site, and a floor plan of the control area. Master functional block diagrams show the complete instrumentation of

TABLE 1-1

MASTER FUNCTIONAL BLOCK DIAGRAM NUMBERING SYSTEM

Drawing Number	*Site Number*	*Site*	*Abbreviation*
T6G-01	1	Cape Canaveral	CNV
T6G-01-2	1a	Grand Bahama Island	GBI
T6G-01-3	1b	Grand Turk Island	GTI
T6G-02	2	Bermuda	BDA
T6G-03	3	Atlantic Ship	ATS
T6G-04	4	Grand Canary Island	CYI
T6G-05	5	Kano, Nigeria	KNO
T6G-06	6	Zanzibar	ZZB
T6G-07	7	Indian Ocean Ship	IOS
T6G-08	8	Muchea, Australia	MUC
T6G-09	9	Woomera, Australia	WOM
T6G-10	.....	Site Cancelled	.....
T6G-11	11	Canton Island	CTN
T6G-12	12	Kauai, Hawaii	HAW
T6G-13	13	Point Arguello	CAL
T6G-14	14	Guaymas, Mexico	GYM
T6G-15	15	White Sands, New Mexico	WHS
T6G-16	16	Corpus Christi, Texas	TEX
T6G-17	17	Eglin, Florida	EGL

Note: Reference to the specific system functional block diagram appears in the associated block of the master functional block diagram for each site. Example—T6G-01-1 is the master functional block diagram of Cape Canaveral; T6G-01-10 is the Canaveral antenna system.

each site, followed by other functional block diagrams that show the instrumentation of each system. A diagram for sites having the same circuit configurations for any system appears only once in this section. These functional block diagrams are derived from the series issued by Western Electric Company, Inc., for each site.

An explanation of the numerical designations used by Western Electric for these diagrams is given in tabular form to assist in cross-referencing the figures in this manual to the diagrams located in the central file at each site.

Table 1-1 indicates the numbering system for the master diagram for each site.

Table 1-2 indicates the numbering system for the diagrams of the individual systems at any site. Additional figures are supplied to illustrate unique circuits. Simplified schematics are used for this purpose and should not be considered as replacements for the actual maintenance schematic diagrams.

1.4 EQUIPMENT ALLOCATIONS

The major components of systems at a site are listed in tabular form in the sections of this handbook describing the site.

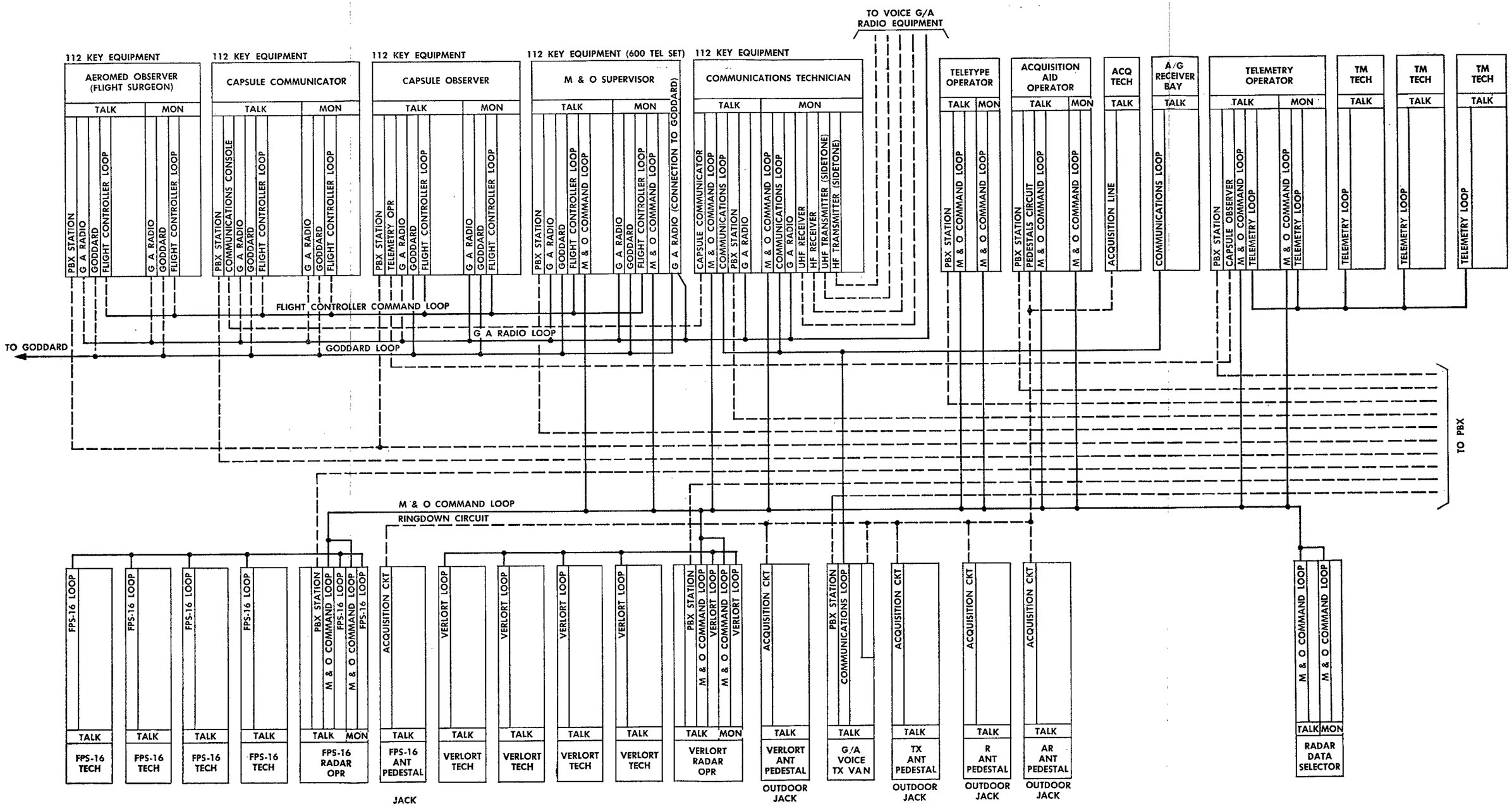


FIGURE 1-2. TYPICAL INTERCOMMUNICATIONS NETWORK

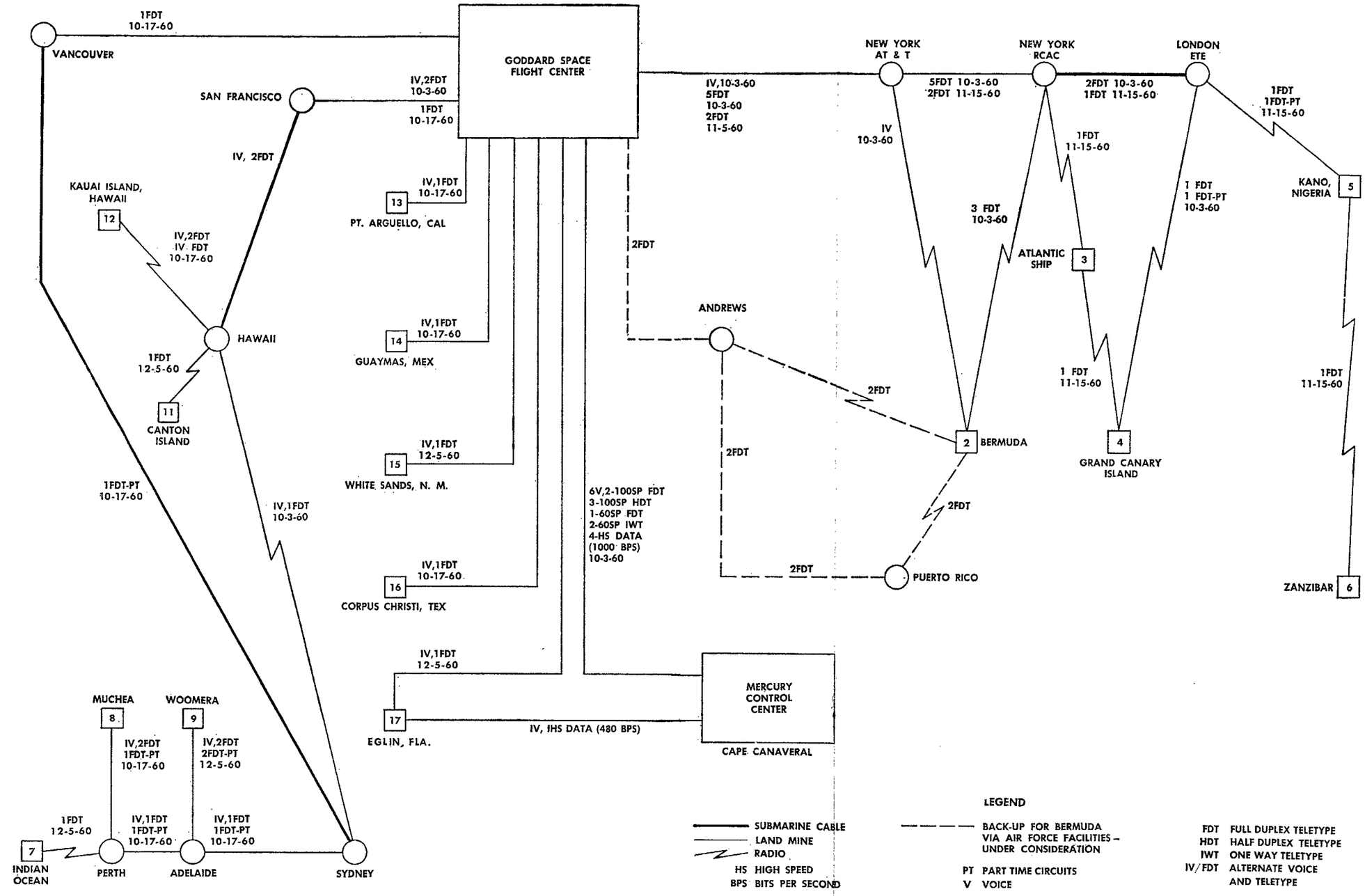


FIGURE 1-3. INTERSITE GROUND COMMUNICATIONS

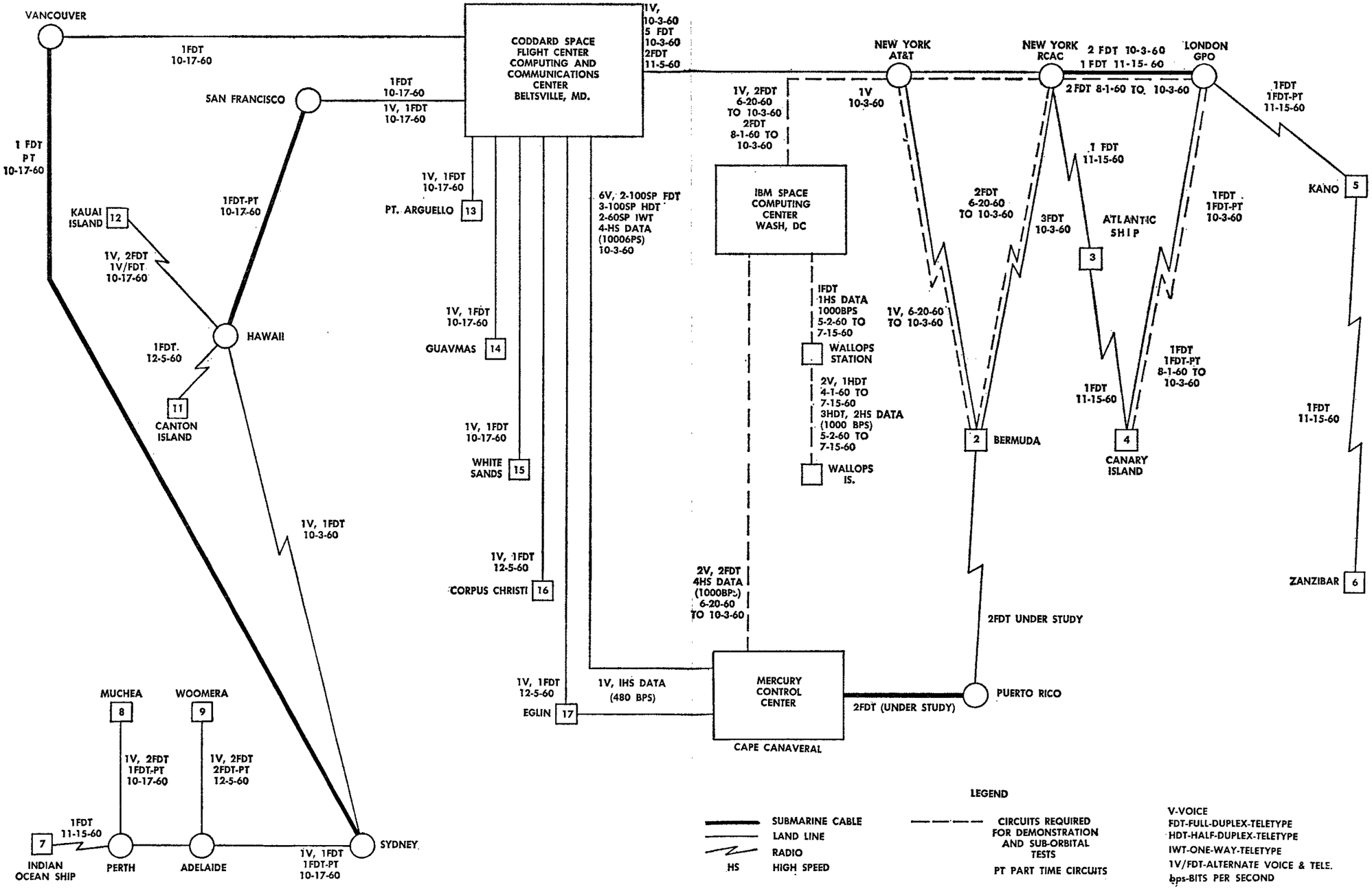


FIGURE 1-3A. INTERIM INTERSITE GROUND COMMUNICATIONS

TABLE 1-2

SUBSYSTEMS FUNCTIONAL BLOCK DIAGRAM NUMBERING SYSTEM

Drawing Number	*System Equipment*
T6G-(Site No.)-10	Pedestal—Antennas—Ground-to-Air
-11	Telemetry
-12	Telemetry Display Control Area—Console
-13	Voice Equipment—Capsule Air-Ground Communications—Command Control Radio
-14	Timing Standard System
-15	Acquisition Aid—Detection & Tracking
-16	
-17	Ground Radio & Teletype
-18	PBX and Site Intercom
-19	Radar Data & Teletype, Plot Board, and Converters
-101/104	Floor Plans for Equipment Areas

Note: The above system is modified for use at Cape Canaveral, due to the complexity of the systems at this site and the consequent use of multiple drawings to illustrate subsystems. These subsystem drawings (and explanation of their numbering system) are excluded from this manual, inasmuch as their inclusion would complicate this manual beyond its intended purpose. Reference to the required number for any of the Cape Canaveral subsystem drawings can be found in the key drawing for the site that lists these items by title and reference.

1.5 SITE ADMINISTRATION

A figure is provided which shows responsibilities and the lines of organization at the sites. Personnel assignments are divided into: (1) operational (pertaining to the actual mission), (2) technical maintenance and operation of the systems and equipment, and (3) general logistic support.

1.6 GEOGRAPHIC AND CLIMATIC DATA

Included in this section is specific information covering temperatures, humidity, rainfall, and general location. Reference is made to associated figures, which show the general area and specific locations of the sites, as well as their svstems.

1.7 TRANSPORTATION AND COMMUNICATIONS

Transportation facilities to the site locations and local site transportation facilities are described in this section. Communications are mentioned, if pertinent.

1.8 SITE PERSONNEL FACILITIES AND SERVICES

1.8.1 Housing

Housing includes furnished and unfurnished houses, apartments, and hotels, as well as special facilities provided for site personnel. Average rental costs are quoted where possible.

MG-101-2

1.8.2 Medical Facilities

Availability of hospital, medical, and dental facilities in the site areas, including any unusual arrangements provided for Mercury personnel, are described. Specific preventive medicines and sanitary precautions are suggested where necessary.

1.8.3 Recreational Facilities

Self-explanatory.

1.8.4 Mail Service

Availability and elapsed time for airmail to New York City are discussed.

1.8.5 Religious Facilities

Denominations represented in the area are discussed.

1.8.6 Clothing

Recommendations are made in accordance with geographic and climatic conditions in the area, as well as the availability and relative cost of these items.

1.8.7 Food

Quality, variety, availability, and cost are discussed where possible. (Specific figures quoted apply at the time of issuance of this handbook and should be verified through lines of organization before departure for the site.)

1.9 MISCELLANEOUS INFORMATION

1.9.1 Money

Included are the rate of exchange, where applicable, and local banking facilities.

1.9.2 Taxes

Unusual items are stressed, but other tax information is included, where available, for real estate and income taxes.

1.9.3 Passport, Visa, Immunization, and Photograph Requirements

These items are summarized for all sites in Figure 1-4.

Certain requirements appearing in the figure are based on requirements of other than the government or area under which they appear. A passport is required for Canton Island, for example, because air transportation back to the United States is by way of a British possession.

Minimum, recommended, and desirable immunizations for personnel are checked in the figure.

IMMUNIZATIONS	GRAND BAHAMA	GRAND TURK	BERMUDA	GRAND CANARY	KANO, NIGERIA	ZANZIBAR	MUCHEA, AUSTRALIA	WOOMERA, AUSTRALIA	CANTON IS.	KAUAI ISLAND, HAWAII	GUAYMAS, MEXICO	ATLANTIC SHIP	INDIAN OCEAN SHIP
SMALLPOX	(X)	(X)	(X)	(X)	(X)	(X)	(X)	(X)	(X)	X	(X)	(X)	(X)
TETANUS	X	X	X	(X)	X	X	X	X	X	X	X	X	X
TYPHOID	X	X	X	(X)	[X]	[X]	X	X	X	X	X	X	X
POLIO	X	X	X	X	X	X	X	X	X	X	X	X	X
TYPHUS	X	X	X	(X)			X	X	X	X	X	X	X
YELLOW FEVER					(X)	[X]							X
CHOLERA						[X]					[X]		X
DIPHTHERIA				(X)									
BIRTH CERTIFICATE	X	X	X	X	X	X	X	X	X	X	X	X	X
PHOTOGRAPHS	X	X	X	X	X	X	X	X	X	X	X	X	X
VISA				X	X	X	X	X			X		X
PASSPORTS	X	X	X*	X	X	X	X	X			X		X

(X) REQUIRED FOR TRAVEL AND PASSPORT

[ ] RECOMMENDED BY LOCAL GOVERNMENT

*ONLY FOR NATURALIZED CITIZENS

INNOCULATIONS NOT IN A BOX OR CIRCLE ARE CONSIDERED ADVISABLE

FIGURE 1-4. PASSPORT, VISA, IMMUNIZATION, AND PHOTOGRAPHIC REQUIREMENTS

Section 2
CAPE CANAVERAL

TABLE OF CONTENTS

Paragraph	*Title*	*Page*
2.1	Purpose of the Site	2-1
2.2	Systems	2-1
	Ground Communications System	2-1
	Timing System	2-2
	Acquisition System	2-5
	Telemetry System	2-5
	Capsule Communications System	2-5
	Radar Tracking System	2-6
	Command Transmitter System	2-7
	Displays	2-8
2.3	Equipment Allocations	2-9
2.4	Equipment Locations	2-9
2.5	Site Administration	2-9
2.6	Geographic and Climatic Data	2-9
2.7	Transportation and Communications	2-14
2.8	Site Personnel Facilities and Services (Housing, Medical Facilities, Recreation Facilities, Mail Service, Religious Facilities, and Clothing)	2-14
2.9	Miscellaneous Information (Money, Passports, Immunization, and Taxes)	2-15

LIST OF ILLUSTRATIONS

Figure	*Title*	*Page*
2-1	Master Functional Block Diagram — Cape Canaveral	2-17/18
2-2	Simplified Intercommunication System — Cape Canaveral	2-19
2-3	Site Intercommunications Flow Chart — Cape Canaveral	2-21
2-4	Radar Data Processing — Cape Canaveral	2-23
2-5	Site Location—Cape Canaveral	2-24
2-6	Floor Plan, TEL-3 Building — Cape Canaveral	2-25
2-7	Site Administration — Cape Canaveral	2-27

LIST OF TABLES

Table	*Title*	*Page*
2-1	Communication Circuits Required of Existing Site Facilities	2-3
2-2	Equipment and Services Supplied by Existing Facilities	2-10
2-3	Equipment Not Supplied by Existing Facilities (Major Items)	2-12

SECTION 2. CAPE CANAVERAL

2.1 PURPOSE OF THE SITE

Cape Canaveral is the control center for the Mercury mission. In addition to the functions noted in Figure 1-1 of this manual, this site:

a. Supervises preflight activities at all sites;

b. Launches the capsule-bearing rocket;

c. Determines the early success or failure of the flight;

d. Initiates corrective or abortive steps necessary due to abnormal rocket and/or capsule performance;

e. Evaluates reports received from other Mercury sites;

f. Initiates and supervises rescue and recovery activities.

Down-range stations operate as accessories to the Canaveral complex. Grand Bahama Island (GBI) and Grand Turk Island (GTI) are used in this way for Project Mercury. Responsibility for continuing the flight or aborting is passed to Bermuda if a final decision is impossible before the capsule passes out of range.

These systems are described in the following paragraph.

2.2 SYSTEMS

Figure 2-1 is a functional block diagram of all systems at the site. Block diagrams of each system at this site are not included in this manual. Refer to the appropriate systems and equipment manuals for further specific information.

2.2.1 Ground Communications System

Figure 1-3 is a map of the intersite circuit arrangements.

2.2.1.1 *Intersite Communications—Teletype* Teletype communications requirements are as follows.

a. Acquisition data at Cape Canaveral (CNV) to point the radar antennas for initial location (acquisition) of the capsule during orbital passes, after a successful launching, transmitted by teletype from the Goddard computer.

b. Radar tracking data from the existing radars to permit accurate orbital computations by the Goddard computer. Data from any of the stations (CNV and GBI FPS-16 radars) is converted to teletype data and sent to the Goddard computer. Raw radar data is transmitted via the IP709 complex during orbit and reentry.

c. Recovery communications circuits connecting to the recovery area of the Control Center.

d. Telemetry summaries consisting of pertinent data on the condition of the Astronaut and the capsule, required at the Mercury Control Center from the other Mercury sites. This information is obtained by telemetry display interpretation at these sites and conversion of this information into a short teletype message. The message is sent to the Goddard computing and communication center where it is relayed to the Mercury Control Center at Cape Canaveral.

e. Order-wire traffic, consisting of general administration, mission hazard, malfunction of equipment, station status, and request for information messages is routed to the Mercury Control Center when applicable. Separate teletype facilities and equipment are required to handle such traffic in order that operational traffic, such as radar tracking and acquisition data, are not delayed or interrupted. These circuits remain in service at all times.

f. Priority circuits (separate circuits) and equipment are provided between the Mercury Control Center and Goddard to permit handling messages involving orders to set retrotimer, etc., with maximum reliability and speed.

Communications between the Mercury Control Center and Bermuda are normally routed by way of Goddard. This teletype circuit is backed up by alternate routing to Bermuda (Figure 1-3).

2.2.1.2 *Intersite Communications—Voice*
Voice communications are provided between Goddard and U.S. stations, Bermuda, Hawaii, and Australia. Direct point-to-point personal communications are required for passing information on Astronaut condition, teletype network supervision and control, and other Mercury project supervisory functions. Connection of the above points to the Mercury Control Center is provided by a number of voice circuits between the Control Center and Goddard (Figure 1-3).

Voice communications provide assistance to radar operators during capsule radar beacon handover between successive stations having overlapping radar coverage. This capability is required at all radar tracking stations from Hawaii to Bermuda, including all continental radar stations. The radar beacon handover voice party line is continuously monitored at Canaveral.

2.2.1.3 *Intrasite Communications*
Voice intercommunications are required between various functional groups at the Mercury Control Center and existing range operational groups. This requirement is met by a specialized communications system which was developed by Western Electric in cooperation with existing range personnel and National Aeronautics and Space Administration (NASA). This system is compatible with the present system in that each Mercury control center operator has the capability of switching to conference circuits both within and external to the Control Center. See Figure 2-2 and Figure 2-3.

Table 2-1 lists the communications circuits required of the existing facilities by Project Mercury.

A recorder connection provided at each control room console records all voice communication from and to the console operator on a multichannel tape recorder.

Control circuitry is required from flight controller (Aeromedical Officer and Flight Director) consoles to the Pad 14 blockhouse sequencer circuitry. Similarly a reciprocal circuit is required for display purposes at the Mercury Control Center at TEL-3. Two additional circuits (from the Pad 14 Blockhouse) to the Mercury Control Center are required for firing and liftoff display signals.

2.2.2 Timing System

A special Mercury timer is provided to time-tag radar data and telemetry data in the Mercury Control Center. The time reference used is that of Greenwich Mean Time (GMT) expressed in hours, minutes, and seconds.

Countdown indications and time tags in areas other than the Mercury Control Center are provided from the existing range timing equipment.

Time signals broadcast from the Bureau of Standards radio station WWV are received at the site on receivers provided for this specific purpose. These signals are used as a reference standard against which a stable one-megacycle oscillator is compared and adjusted. Successive frequency division circuits supply frequencies from one kilocycle to one pulse per minute. During this procedure, adjustments are made as necessary to synchronize the frequency of the locally generated signal with the frequency of the received signal. A check of the system is provided by a visual comparison on an oscilloscope of the one-pulse-per-second output of the timing system and the once-per-second tone burst from WWV.

The outputs of this system are as follows.

a. An output representing GMT in hours, minutes, and seconds. This is used in the data processing and data conversion equipment to time-tag the radar data and drive certain control center displays.

b. A pulse from the timing equipment every six seconds which causes radar data to be read out.

c. A pulse train with serial time of day (based on GMT) is supplied for use with the telemetry data.

NOTE

The permissible time deviation from WWV time by existing range time equipment is ±3 milliseconds.

TABLE 2-1
COMMUNICATIONS CIRCUITS REQUIRED OF EXISTING SITE FACILITIES

Circuit		*NASA Circuit Requirements*
Origin	*Termination*	
Telephone Central	Mercury Control	3 — 3-kc auxiliary telephone circuits 1 — Circuit for recovery operations
Pads 5 and 6	Mercury Control	2 — 3-kc circuits for command control coding data
Pad 12	Pad 14	1 — Video circuit for TV camera at Pad 12
Flight Monitor Trailer	Mercury Control	2 — 3-kc command control data circuits
G.E./Burroughs Building	Bell System Term.	2 — 3-kc circuits for digital data to Goddard
IP-709 Building	Bell System Term.	2 — 3-kc circuits for digital data to Goddard
TEL-2 Building	Mercury Control	2 — 25-kc telemetry composite 1 — 3-kc signal strength multiplex 8 — Atlas telemetered quantities 1 — 3-kc voice circuit (UHF A/G receiver) 9 — Control circuits (UHF A/G receiver) 2 — Control circuits (UHF test signal control)
Range Central	Mercury Control	22 — Circuits countdown indication 1 — 3-kc circuits secondary radar data (CADDAC) 2 — 3-kc circuits digital synchro data to CADDAC 30 — 3-kc voice intercom circuits 1 — Circuit to recovery 4 — 3-kc circuits for command control data 4 — 3-kc circuits (command control) 2 — DC hold-proceed control circuits 1 — Hold-proceed indicator circuit 1 — Circuit liftoff signal 1 — Firing signal circuit
Mercury Control through Range Central	Grand Bahama and Grand Turk	1 — Split channel voice circuit (G/A) (trans. modulation) 1 — Full-channel voice (UHF and HF A/G receiver) 23 — Narrow-band selection and keying circuits (G/A) 1 — 25-kc telemetry composite (up-range)

(Continued)

TABLE 2-1. COMMUNICATIONS CIRCUITS REQUIRED OF EXISTING SITE FACILITIES *(Continued)*

Circuit		
Origin	*Termination*	*NASA Circuit Requirements*
Command Control Building	Mercury Control	12 — DC control circuits (remote control G/A voice) 8 — 3-kc circuits G/A voice 2 — 3-kc circuits FRW-2 voice modulation 4 — 3-kc circuits digital synchro data (ant.)
Bell System Term.	Mercury Control	4 — 3-kc voice circuits (1 order-wire, 3 supervisory) 1 — Circuit for recovery operations 4 — 3-kc digital data circuits (to Goddard) 5 — 3-kc digital data circuits (simulation & control to Goddard) 8 — Full-duplex TTY circuits 2 — Simplex TTY circuits
GE/Burroughs Building	Mercury Control	3 — 3-kc digital data circuits 1 — 4-kc digital T/M data (to high-speed buffer)
IP-709 Building	Mercury Control	1 — 4-kc digital T/M data (to high-speed buffer) 3 — 3-kc radar data (from IP-709 building)
Pad 14	Mercury Control	2 — Video circuits (TV launch display) 10 — DC control circuits (TV camera select.) 2 — 3-kc command control coding

2.2.3 Acquisition System

An acquisition data console located in the TEL-3 Building controls the steerable antenna systems in conjunction with the normal range acquisition facilities. These facilities are the TLM-18 system and the Central Analogue Data Distributing and Computing System (CADDAC).

Input information to the acquisition data console is as follows.

a. From manual synchro input. The console operator positions elevation and azimuth synchro generators and indicators in accordance with information from the computing center.

b. From the TLM-18 system in the Central Control Building.

c. From the CADDAC system, in the Central Control Area. The local FPS-16 and down-range radar supply positional data to this system.

Positional data supplied to the acquisition data console is used to aim the steerable radar antennas by Canaveral personnel as well as controlling the ground-air radio communications antennas. Acquisition data for manual pointing of the Grand Bahama and Grand Turk antennas is supplied to these stations via the existing communications network to these points from Cape Canaveral.

2.2.4 Telemetry System

The telemetry system at Cape Canaveral provides telemetry signals from equipment at the TEL-2 and TEL-3 buildings plus signal inputs from telemetry receivers, demodulators, and data transmission equipment at Grand Bahama and Grand Turk.

The installation at Cape Canaveral includes two TLM-18 antennas, which supply the system consisting of receivers, combiners, and a recorder at the TEL-2 Building as well as the complete telemetry, demodulation, decommutation, and monitoring equipment in the TEL-3 Building. A patch panel and a signal control panel (also TEL-3) allow selection and display of any of the above signal sources. Two capsule-to-ground transmitting frequencies, multiple receivers, antenna space diversity, use of signal combining equipment, and switching options ensure system reliability. All sources of information are recorded, both at the receiver locations and in the Telemetry and Capsule Communications Equipment Room of TEL-3. In addition to this equipment, pen recorders and an oscillographic recorder provide quick-look presentations.

Grand Bahama Island determines which down-range telemetry information is received in Cape Canaveral. Either Grand Bahama or Grand Turk telemetry is forwarded according to its relative strength. Tape records are kept of the received signals at both locations, however, to allow postmission examination. The down-range telemetry composite is received at range control and sent via intrasite cable facilities to the TEL-3 Building.

2.2.5 Capsule Communications System

Two amplitude modulation systems are used in capsule communication, both for transmitting and for receiving. These systems operate in the high-frequency (HF) and ultra-high-frequency (UHF) bands, providing direct voice communications between the capsule and three flight controller console positions in the Mercury Command Post (TEL-3 Building):

a. Flight Director;
b. Flight Surgeon;
c. Capsule Communicator.

In addition to the above systems, the command transmitter system may be used for voice transmission to the capsule from the site. This is an emergency form of communication, and is discussed in the paragraph Command Transmitter System 2.2.7. Transmission from capsule to the site utilizes the telemetry system on a keyed interrupted continuous-wave (ICW) basis.

A communications technician console is located in the Telemetry and Capsule Communications Equipment Room of the TEL-3 Building.

Inputs to this console include:

a. Local HF and UHF receiver audio;

b. Down-range HF/UHF receiver audio from Grand Bahama or Grand Turk;

c. Audio from the flight controller consoles, which are equipped for capsule communication.

Outputs from this console include the following.

a. Audio modulation for HF and UHF transmitters (local or down-range equipment).

b. Keyed control of test signals for both local receiver systems.

c. Supervisory control functions to select local and/or down-range transmitters. Down-range transmitter selection is via the existing supervisory control system.

d. Audio traffic to tape recording facilities.

The Communications Technician monitors all Cape Canaveral receivers and selects either the HF or the UHF receiving system, and the better signal of the system selected.

2.2.5.1 *High-frequency System*
Two fixed receiving dipole antennas employing space diversity are connected to receivers located in the Telemetry and Capsule Communications Equipment Room (in TEL-3). Receiver audio output is also recorded on the 14-track instrumentation tape recorder. Down-range HF receiver signals are sent from Grand Bahama and Grand Turk after demodulation to the communications technician console by way of the Central Control Building.

A dipole antenna, mounted on the same steerable transmitting and command (T&C) pedestal which supports the quad-helix transmitting antenna, is used for high-frequency transmitting. The source of energy for this antenna is either of two transmitters located in a transmitter van. Switching this antenna between transmitters is done in a transmitter van located close to the Command Transmitter Building. Transmitter power is 100 watts.

2.2.5.2 *Ultra-high-frequency System*
Two TLM-18 antennas (also used for telemetry signals) are used for receiving in conjunction with preamplifiers and receivers. A spare receiver is supplied for standby use. As in the telemetry system, one of the receivers (along with a UHF signal generator) is located in the TEL-2 Building. The remaining UHF receiver and standby unit are in the TEL-3 Building.

Two UHF transmitters are located in the transmitter van, under control of the Communications Technician. Transmitter power output is 250 watts in the frequency range of 2-26 mc and 225 watts at 32 mc. A steerable quad-helix antenna, mounted on an antenna pedestal designated T&C, is supplied. It can be used with either of the above UHF transmitters. Antenna switchover is accomplished in the transmitter van.

All air-ground communications are tape recorded. Keying of HF and UHF transmitters at Cape Canaveral and down range is recorded on a 100-channel events recorder.

Signal generators are provided with associated antennas for testing receiver operation. Both HF and UHF signals are available from the communications console in the TEL-3 Building. A UHF/HF signal generator is located in the TEL-2 Building. Only the UHF section of the TEL-2 signal generator equipment is used for Project Mercury purposes. All signal generators are under control of the Communications Technician in TEL-3.

2.2.6 Radar Tracking System

Radar tracking data is required from existing facilities for launch, orbital, and reentry calculation. This data enters the IBM 709 Impact Predictor Computer at 10 samples per second, via existing transmission facilities. During the orbital and reentry phase, this radar data also enters the Goddard computers at a rate of one sample per six seconds over a teletype link. Switching options allow radar and data processing equipment flexibility to increase reliability of the data handling system. A brief description of the system and its options follows (Figure 2-4).

The IBM 709 Impact Predictor Computer makes available processed data from either the AZUSA or FPS-16 radars depending upon which tracking data is being used by the computer during the launch phase. Selection of which tracking data is used by the computer is under control of the program operator. This data is made available on the basis of noninterference with range safety functions.

If the IBM 709 data output from Canaveral fails, manual switching allows the raw data from the FPS-16 to be sent to Goddard over the same facilities. A simultaneous input to the two 7090 computers at Goddard from the GE/Burroughs tracking system, as well as from the Canaveral IBM 709 data input, ensures reliability.

Certain signals derived from both the capsule telemetry and the vehicle telemetry are time multiplexed onto both sets of high-speed data transmission lines carrying tracking data to the Goddard computers. Both Goddard computers simultaneously compute data quality plots for each set of input tracking data. They also compute a complete set of display data for either AZUSA/FPS-16 or GE/Burroughs input data. The selection of the desired data input is made at the Control Center and remoted to Goddard. In addition, data is remoted directly from the GE/Burroughs system to the Mercury Control Center.

The Data Selection Room Observer selects either AZUSA/FPS-16 derived or GE/Burroughs derived data from Goddard to drive the main Mercury control center displays. The selector switch signals the Goddard computer through the telemetry transmitter buffer to send either AZUSA/FPS-16 or GE/Burroughs derived data for the Mercury control center operation room displays. The Data Selection Room Observer has the additional option of selecting certain locally processed direct GE/Burroughs display data in place of Goddard display data, but regardless of the observer's selection of data for operation of the main Mercury control center displays, his data quality monitoring plots continue to operate through the launch phase to indicate quality of data from both sets of Goddard data and from the direct GE/Burroughs link.

During the launch phase, the Goddard computers compute and transmit acquisition data to Bermuda based on data supplied by the Canaveral equipment.

2.2.7 Command Transmitter System

Radio command control of rocket and capsule is required from prelaunch to flight completion, to furnish ground command backup of certain internally programmed capsule events. Under emergency conditions, the command control system can be used to furnish a ground-to-capsule voice communications link.

Commands can be initiated from several locations, as follows:

a. No. 1 Launch Vehicle Blockhouse (Abort);

b. No. 2 Launch Vehicle Blockhouse (Abort);

c. No. 2 Launch Vehicle Flight Monitor Center (Abort, Fire Retrorockets);

d. Mercury control center consoles (Abort, Change Retrotimer, Fire Retrorockets).

The Canaveral remoting system (frequency shift tone keyers) is used to connect the source of commands to the Mercury coder control when these sources are external to the Mercury Control Center. Sources within the Control Center are connected to the coder control by cable. The coder control in the Mercury Control Center transmits coding data via the same remoting system to an existing KY-171 coder unit located in the Command Transmitter Building. The output of this unit modulates the existing command transmitter (AN/FRW-2), which feeds the command antenna through a 10-kw amplifier (240D-2 by Collins-Alpha).

During launch phase, the existing range command antennas are used. For subsequent passes and reentry, the Mercury quad-helix steerable transmitting antenna is used. Antenna patching facilities are provided in the Canaveral Command Control Building by which the 10-kw command control system can be transferred from the Canaveral fixed antenna to the steerable antenna on the T&C pedestal. This is under direction of the Mercury Command Post.

Signals from the existing output monitoring system of the FRW-3 receiver in the Central Control are connected to the Mercury Control Center for monitoring and recording purposes.

The emergency voice communications backup are provided by the addition of a voice modulator at the Command Control Building, a patch panel, and a modulator lookout device (a key-locked switch), controlled from the assistant

range safety officer console. Voice modulation is accomplished by frequency modulation of the UHF command carrier, when permitted by the Range Safety Officer.

When fuel cutoff is initiated as a range safety function, the fuel cutoff command is transmitted directly to the FRW-2 transmitter through the existing command control remoting system, but not through the Mercury coder control unit.

System reliability is ensured by duplication of equipment for each of the command systems. A high-power command system employs a 10-kw final amplifier driven by the FRW-2 unit (the latter unit is usually employed as a 500-watt, nominal rating transmitter). An identical 10-kw system is automatically switched into service on failure of the basic unit.

A low-power command transmitting system is also supplied employing both normal and stand-by FRW-2 transmitters. Both transmitters are normally energized, but only one is connected to the existing range antenna at a time. Amplifier switching is done at the Range Command Control Building.

2.2.8 Displays

An area of the Mercury Command Post, which is located in the TEL-3 Building (Figure 2-5) is provided for the Flight Controllers, observers, and visitors to witness the operations during a mission. This area is at the front of the Mercury Command Post and contains a group of displays designated the operations summary display. The main section of this display contains a large map of the world, illustrating the location of all Mercury range stations and the track of the capsule. As the mission progresses, a miniature capsule moves along the track indicating the actual position of the capsule. A small circle ahead of the capsule indicates the capsule landing point if the retrorockets are fired at that instant.

A number of time-data indicators are placed along the top of the map. Reading from left to right across the top of the map, these displays are:

a. GMT in hours, minutes, and seconds;

b. Orbit number;

c. Countdown time in hours, minutes, and seconds;

d. Elapsed time in hours, minutes, and seconds;

e. Time to retrofire in hours, minutes, and seconds;

f. A hold indication, located between the orbit number display and the countdown display, which is illuminated when the countdown is interrupted.

Rectangular displays are located on the lower left and upper right of the world map, which are connected by dotted lines to the range stations. Rings of red, yellow, and green light up around each station on these displays, which are under control of the Network Status Monitor, indicating the overall status of the station. A flashing light ring indicates contact between any station and the capsule.

Completing the operations summary display are trend charts to the left and right of the world map. Physical condition of the Astronaut and environmental conditions of the capsule are displayed here on indicators, which are under control of two operators located behind the wall map. The indications are based on data collected from telemetry summary messages received from the range stations. The indicators are manually controlled.

There are four plotboards located in front of flight controller positions numbered 13 and 14 in Figure 2-5. Arbitrarily numbering these boards from left to right, their functions are as follows.

a. To display predicted landing points and landing recovery area.

b. To plot range versus altitude in nautical miles.

c. To plot gamma, which is defined as the angle the capsule-velocity vector makes with the local horizontal velocity ratio. (Velocity ratio is the ratio between the present capsule velocity and the desired capsule velocity.) This plotboard is marked with the outside limits for an acceptable orbit. After insertion, the axes of

the orbit and the radius of the earth are related as a function of elapsed mission time in hours by this plotboard, as well as the capsule altitude versus elapsed mission time.

d. To display, during the powered portion of the flight, the telemetered longitudinal acceleration at the top of this board and the computed inertial velocity at the bottom of the board, as a function of elapsed time, until sustainer engine cutoff. At an elapsed time of 175 seconds after liftoff this plotboard displays the predicted altitude of capsule insertion into orbit and a velocity component. These quantities are produced by the GE/Buroughs guidance computer, and verify performance of the capsule guidance system and that the capsule flight has the desired trajectory. After insertion this plotboard displays the eccentricity and orientation of the orbit with respect to the earth, related to the elapsed mission time in hours. This information is essential in determining when capsule reentry can be safely initiated.

In addition to the displays described above, there are 14 flight controller positions located in the Mercury Command Post. The functions and the capabilities of each of these manned positions are described in detail in MO-118C, *Flight Controller–Cape Canaveral.*

The designations of the personnel and their functions are as follows:

a. Operations Director;
b. Flight Director;
c. Flight Dynamics Officer;
d. Capsule Communicator;
e. Flight Surgeon;
f. Capsule Environment Monitor;
g. Capsule Systems Monitor;
h. Retrofire Controller;
i. Recovery Status Monitor;
j. Vehicle Telemetry Monitor;
k. Network Status Monitor;
l. Range Safety Observer;
m. Network Commander;
n. Recovery Director.

Television monitors are provided for observation of the launching operations. Three cameras are located at complex No. 14, and one camera is located at complex No. 12.

Additional displays provided in the TEL-3 Building, external to the Mercury Command Post, for the use of maintenance and operating personnel are as follows:

a. Telemetry coarse monitor;
b. Telemetry fine monitor;
c. Telemetry signal strength multiplexer and display monitor;
d. Acquisition data console.

2.3 EQUIPMENT ALLOCATIONS

Equipment and systems used in Project Mercury are, in part, unique to Project Mercury and are supplied, in part, by the existing range. These items are shown separately in the following tables:

Table 2-2—Equipment and Services Supplied by Existing Facilities.

Table 2-3—Equipment Not Supplied by Existing Facilities (Major Items).

2.4 EQUIPMENT LOCATIONS

Figure 2-5 is a map of Cape Canaveral showing the location of the various buildings associated with Project Mercury. Equipments to be found in each building are listed in Figure 2-6.

2.5 SITE ADMINISTRATION

See Figure 2-7.

2.6 GEOGRAPHIC AND CLIMATIC DATA

Cape Canaveral is on the east coast of Florida at 28°28′ N, 80°34′ W. It is approximately 60 miles southeast of Daytona Beach and 60 road miles east of Orlando. Cape Canaveral is on a flat peninsula bounded on the east by the Atlantic Ocean and on the west by the Banana River. Merritt Island is between the peninsula and the mainland. Temperatures range from 30° F to 100° F in winter and summer respectively. The average temperature in summer is 80.6° F, in winter 64.7° F. Rainfall averages 20 inches per year.

TABLE 2-2
EQUIPMENT AND SERVICES SUPPLIED BY EXISTING FACILITIES

Item	*Location*
Target Acquisition and Antenna Control System (Reference Drawing T6G-01-32)	Central Control
1. Synchro circuits between the TLM-18 at TEL-3 and the Mercury Control Center	Central Control
2. CADDAC with provision for additional 2 inputs and 1 output (including switching equipment)	
Telemetry System (Reference Drawing T6G-01-33,-34,-35)	TEL-3
1. TLM-18 antenna and tracking system	TEL-3
2. TLM-18 preamplifiers	
3. TLM-18 multiplex	TEL-3
4. Terminal equipment for down-range T/M composite and signal strength	TEL-3
5. Terminal equipment for Atlas T/M, 2 T/M composites, and signal strength from T-2	TEL-3
6. TLM-18 routine test equipment	TEL-3
7. TLM-18 antenna and tracking system	TEL-2
8. TLM-18 preamplifiers	TEL-2
9. TLM-18 multiplexers	TEL-2
10. Signal strength subcarrier oscillators	TEL-2
11. Tape recorder/reproducer (6 tracks plus timing)	TEL-2
12. Line terminal equipment consisting of two wide-band terminals for T/M composites and one terminal amplifier system for multiplexed signal strength transmission	TEL-2
13. Routine test and calibration equipment	TEL-2
14. Equipment for transmission of eight Atlas T/M quantities from T-2 to T-3 with DC analog output at T-3	TEL-2
15. Telemetry function patch panel	TEL-2
16. Tape recorder/reproducer (6 tracks plus range timing)	GBI/GTI*
17. Signal strength subcarrier oscillators	GBI/GTI
18. Line terminal equipment (submarine cable)	GBI/GTI Central Control
19. Tape patch panel	GBI/GTI
20. Routine test and calibration equipment	GBI/GTI

* GBI/GTI = Grand Bahama Island/Grand Turk Island

(Continued)

TABLE 2-2. EQUIPMENT AND SERVICES SUPPLIED BY EXISTING FACILITIES *(Continued)*

Item	*Location*
Radar Data Handling System (Reference Drawing T6G-01-32)	Terminated at TEL-3
1. Radar data source (nonprocessed serial data from Cape FPS-16, GBI, and San Salvador)	
Command Control System (Reference Drawing T6G-01-45)	
1. AN/FRW-2 system	Command Control Building and GBI
2. Two 10-kw amplifiers	Command Control Building
3. Fixed-position antennas	Command Control Building
4. Antenna patch panel at command control	Command Control Building
5. Voice modulation program panel	Command Control Building
6. Tone remoting equipment	TEL-3 and other existing facilities
7. Circuits external to Mercury Control Center	
8. AN/FRW-3 monitor receiver, decoder, and antenna at Range Central Control (remoted to T-3)	Central Control
9. Space for antenna tower adjacent to Command Transmitter Building	Command Control Building
Air Ground Communications System (Reference Drawing T6G-01-38 and T6G-01-39)	
1. UHF (voice channel) coaxial cable from TLM-18 antenna system to the TEL-2 UHF receiver	
2. Receiver audio and control circuits to TEL-3	
3. UHF (voice channel) coaxial cable from the TLM-18 antenna system to the receiver system	TEL-3
5. Connections to the existing remote control system	Central Control
6. Utilities from Command Control Building to transmitter shelter	Command Control Building
7. Communications and control circuits between transmitter shelter and TEL-3	
8. Connections to the existing remote control system (supervisory control)	GBI/GTI
9. Services, materials, and installation work	GBI/GTI
10. Tone remoting equipment between subcable terminal and Receiver Building	GBI

(Continued)

TABLE 2-2. EQUIPMENT AND SERVICES SUPPLIED BY EXISTING FACILITIES *(Continued)*

Item	*Location*
Ground Communications	
1. Communication circuits	
2. One existing intercommunication system end instruments	TEL-3
3. Twenty-eight existing communication system line amplifiers	TEL-3
4. Line amplifier equipment for TV remoting	TEL-3
Timing and Firing (Reference Drawing NASA LD-1880-32)	
1. Countdown signals to TEL-3 Control Center	
2. Existing timing system outputs	Canaveral complex, GBI, and GTI
3. Two HOLD-PROCEED control circuits and one HOLD-PROCEED indicator circuit	Blockhouse 14
4. FIRING AND LIFTOFF signals	Blockhouse 14

TABLE 2-3

EQUIPMENT NOT SUPPLIED BY EXISTING FACILITIES (MAJOR ITEMS)

System	*Equipment*	*Type or model*	*Supplied by*
Acquisition	Active acquisition aid		Cubic
	Acquisition data console		Bendix Radio
Telemetry	Preamplifier	PR-203	Nems-Clarke
	Receiver	1412	Nems-Clarke
	Receiver	1434	Nems-Clarke
	Diversity combiner	DCA-500	Nems-Clarke
	Decommutators	TDS-90	Arnoux
	Discriminators	TDA-102	Bendix
	Tape recorder	FR-114	Arpex
Radar (existing range facility)			
Ground Communications	This unit connects to the existing intercommunications system. Added to the present system are:		
	End instruments		
	Line amplifiers		

(Continued)

Table 2-3. EQUIPMENT NOT SUPPLIED BY EXISTING FACILITIES (MAJOR ITEMS) *(Continued)*

System	*Equipment*	*Type or model*	*Supplied By*
Capsule Command	Coder controller	C-1669	
	Coder	KY-171	
Air-Ground Communications	HF transmitter (2)	CMG-1 CS-2029 Trans. T282/GR	Gates
	UHF transmitter (2)	AN/GRT-3 (MOD MD141 A/GR)	Radio Receptor
	UHF receivers (2)	R-278B/GR	Collins
	Distribution panel	J-390/GR	Collins
	HF receivers (2)	R-390A/URR	G.F.E. (Collins)
	HF/UHF signal generator (2)	BXR-66300	Bendix
	Communications technician console assembly	BXR-CTC 500	Bendix
	Diversity combiner	BXR-DDU 100	Bendix
	(microphone amplifiers)	M5167	Gates
Antennas	Pedestal, command, and transmit		Canoga Cubic
	UHF quad-helix with command antennas		Canoga Cubic
	HF signal generator	TMC-VRA-2	
	UHF signal generator antenna	TACO-AS-390A/SRC	
Timing	Time standard rack assembly	——	Bendix Radio
Data Processing	Analog-to-digital transmitter (2)	4005T	Milgo
	Analog-to-digital receiver (2)	4005R	Milgo
	Buffer dual-data transmitter	4008T	Milgo
	Dual-data receiver	4008R	Milgo
	Digital data to teletype converter	165	Milgo
	Cartesian/polar converter	4003	Milgo
	Plotboard	3010	Milgo
Displays	Operation Director	Console	Stromberg-Carlson
	Flight Director or Flight Dynamics Officer	Console	Stromberg-Carlson
	Capsule Environment Monitor	Console	Stromberg-Carlson
	Capsule System Monitor	Console	Stromberg-Carlson
	Flight Surgeon (astrophysical display)	Console	Stromberg-Carlson
	Capsule Communicator	Console	Stromberg-Carlson
	Recovery Status Monitor	Console	Stromberg-Carlson
	Recovery Director	Console	Stromberg-Carlson
	Missile Telemetry Monitor	Console	Stromberg-Carlson
	Range Safety Observer	Console	Stromberg-Carlson
	Range Status Monitor	Console	Stromberg-Carlson
	Network Commander	Console	Stromberg-Carlson
	TV monitors	Console	RCA/Western Electric

(Continued)

TABLE 2-3. EQUIPMENT NOT SUPPLIED BY EXISTING FACILITIES (MAJOR ITEMS) *(Continued)*

System	*Equipment*	*Type or model*	*Supplied By*
	Wall displays:		
	Mercator world map	Nominal and actual capsule track plus predicted impact point	Stromberg-Carlson
	Countdown indicator	Minutes and seconds to launch	Stromberg-Carlson
	Orbit number indicator	2-digit display	Stromberg-Carlson
	Time displays	a. GMT	Stromberg-Carlson
		b. GMT at time of liftoff	Stromberg-Carlson
			Stromberg-Carlson
		c. Mission elapsed time	Stromberg-Carlson
		d. Time to retrofire	Stromberg-Carlson
	Field station status board	——	
Ground Communications	Teletype	28ASR (send-receive)	Teletype Corp.
		28RO (receive only)	Teletype Corp.
		28ROTR (receive only —typing reperforator)	Teletype Corp.

2.7 TRANSPORTATION AND COMMUNICATIONS

Rail transportation is not provided to Cape Canaveral because of the excessive number of bridges required for trains in this type of terrain. Freight and passenger rail traffic terminate 14 miles from Canaveral at the Rockledge Station, via the Florida East Coast R.R.

Eastern Airlines provides service to Orlando and to Melbourne, which is 25 road miles from Canaveral. Rental car service is available at the Orlando Airport and at Cocoa Beach. Due to the distances between the surrounding towns, rental cars are considered more economical than taxis. Greyhound Bus Line serves U.S. Route 1, which passes through Cocoa.

Rockledge and Eau Gallie cable and telephone facilities are available.

2.8 SITE PERSONNEL FACILITIES AND SERVICES

Personnel assigned to Cape Canaveral live in offsite housing. Apartment rental rates vary with the seasons. They are generally highest from February through March, somewhat reduced in April and May, and lowest during remaining months of the year. A lower-cost example of current furnished apartment rental varies with the season from $200.00 to $250.00 monthly, and is for a unit consisting of living room, bedroom, bath, and efficiency kitchen. Hotel rates vary from a minimum of $8.00 per day to approximately $20.00 per day, excluding meals. New two- and three-bedroom homes are advertised in nearby towns. Prices for one representative group of homes range from $9,500 to $11,800. Food and clothing costs are considered similar to those of metropolitan New York.

The Weusthoff Hospital under construction (March, 1960) in the Cocoa Beach area, will supply modern, adequate facilities. Brevard Hospital is now serving Eau Gallie and vicinity. New York, New Jersey, and other states' hospitalization service plans are honored by the local hospitals. It is suggested that you verify

the status of your hospitalization plan in this area with both interested parties. Doctors, dentists, and pharmacies are located in communities near the site.

Sheltered harbors, the Indian River, and the Banana River waterways encourage boating and fishing. Swimming, golf, shuffleboard, tennis, and bowling facilities can be found in and near the neighboring communities.

A Civic Center in nearby Eau Gallie is available for music, art, dramatics, and sports. Varied presentations ranging from light opera, band and symphony concerts, to hobby and scouting shows, make a diversified recreation program available for all. Library facilities are also available in Eau Gallie.

Airmail service to New York requires two days.

The following denominations are found in towns listed. The list is not complete but serves as a guide.

Cocoa: Baptist, Episcopal, Methodist, Mormon, Presbyterian, and other denominations.

Rockledge: Adventist, Catholic, Jehovah's Witnesses, Lutheran, and Presbyterian.

Merritt Island: Baptist, Christian Church, Episcopal, Methodist, and other denominations.

Cocoa Beach: Baptist, Catholic, Episcopal, Jewish, Methodist, and other denominations.

A variety of clothing will be necessary due to the temperature variations throughout the year. Temperature averages for the seasons, noted in paragraph 2.6 of this text should be considered in making wardrobe selections. Local stores supply a wide variety of clothing and other consumer commodities.

2.9 MISCELLANEOUS INFORMATION

Local banks offer complete banking services.

Passports are not necessary at the Canaveral site.

Immunizations are not required at the Canaveral site.

Florida has no income tax. There is a sales tax of 3 percent.

A homesteaders reduction of $5,000 from the assessed valuation of property purchased in the state is available to those who occupy the property as their legal permanent residence. The real estate tax rate is determined by county, city, and school department costs.

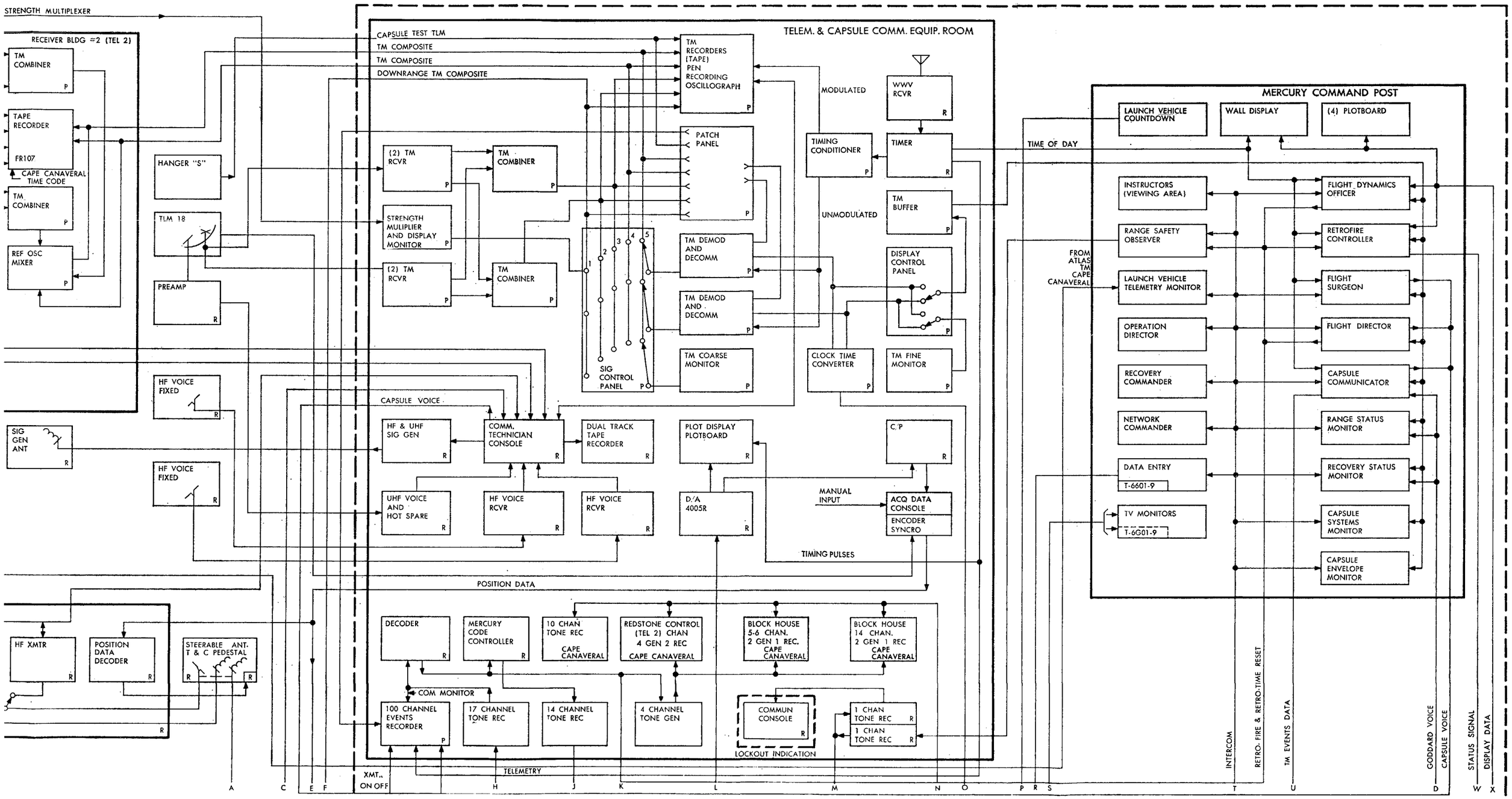


FIGURE 2-1A. MASTER FUNCTIONAL BLOCK DIAGRAM — CAPE CANAVERAL

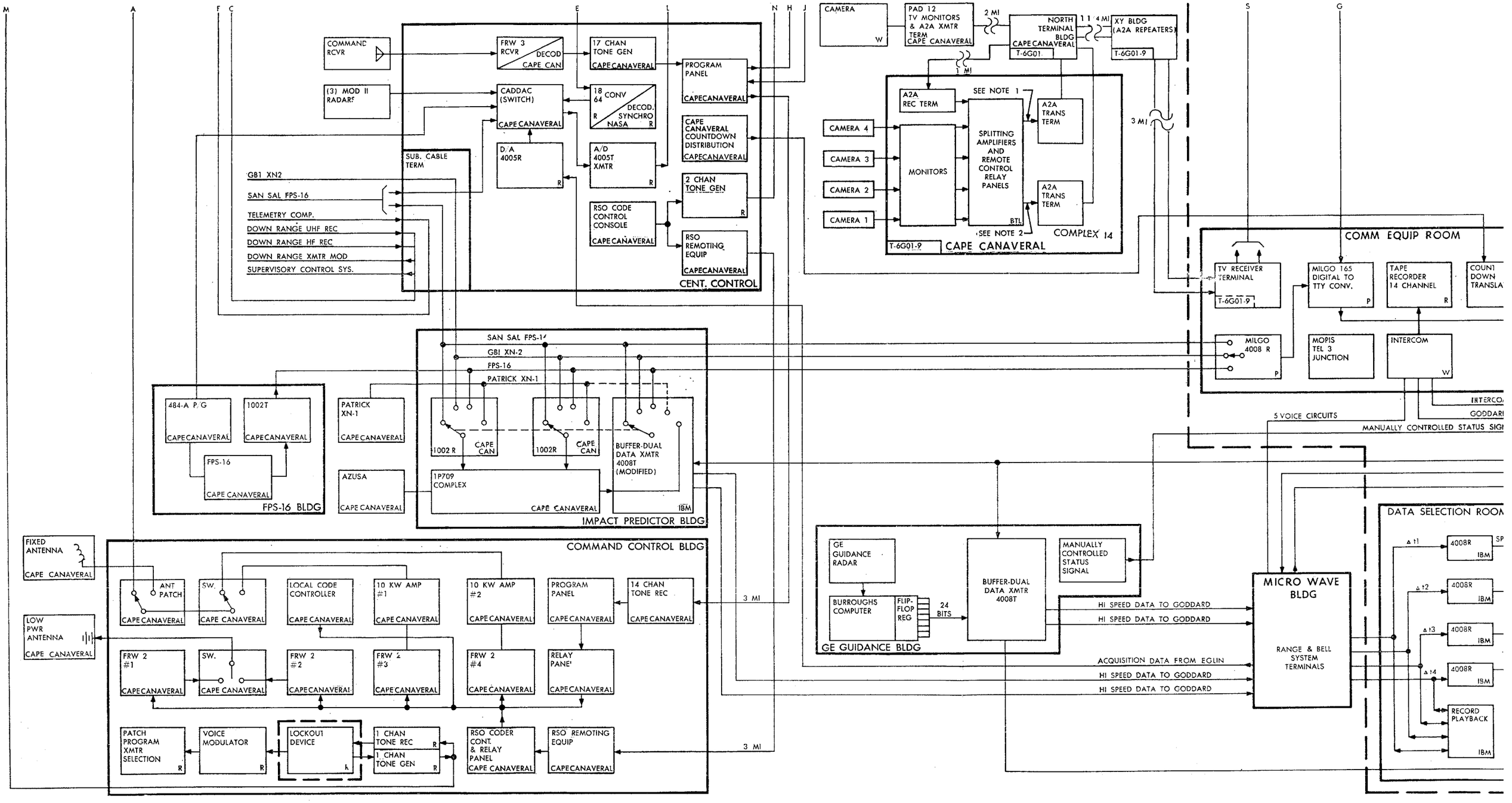


FIGURE 2-1B. MASTER FUNCTIONAL BLOCK DIAGRAM — CAPE CANAVERAL

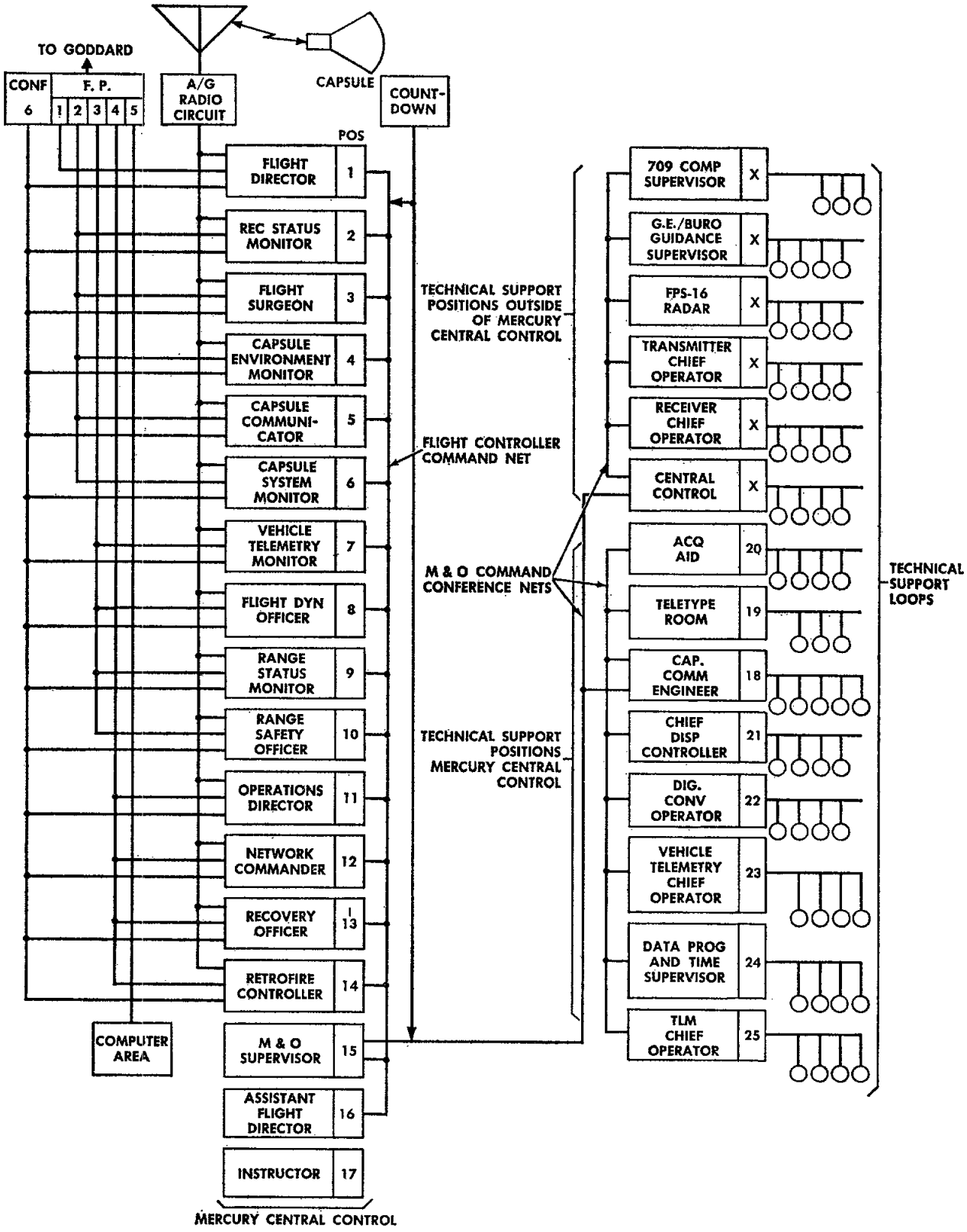


FIGURE 2-2. SIMPLIFIED INTERCOMMUNICATION SYSTEM — CAPE CANAVERAL

KEY NUMBER ASSIGNMENT

| REMOTE LOC | MERC LOOP | MERC LOOP | F. P. TO GODDARD LOOP | | LOOP | LOOP | LOOP | MERC LOOP | F. P. | F. P. PT/PT | EX INTER NETS | | |

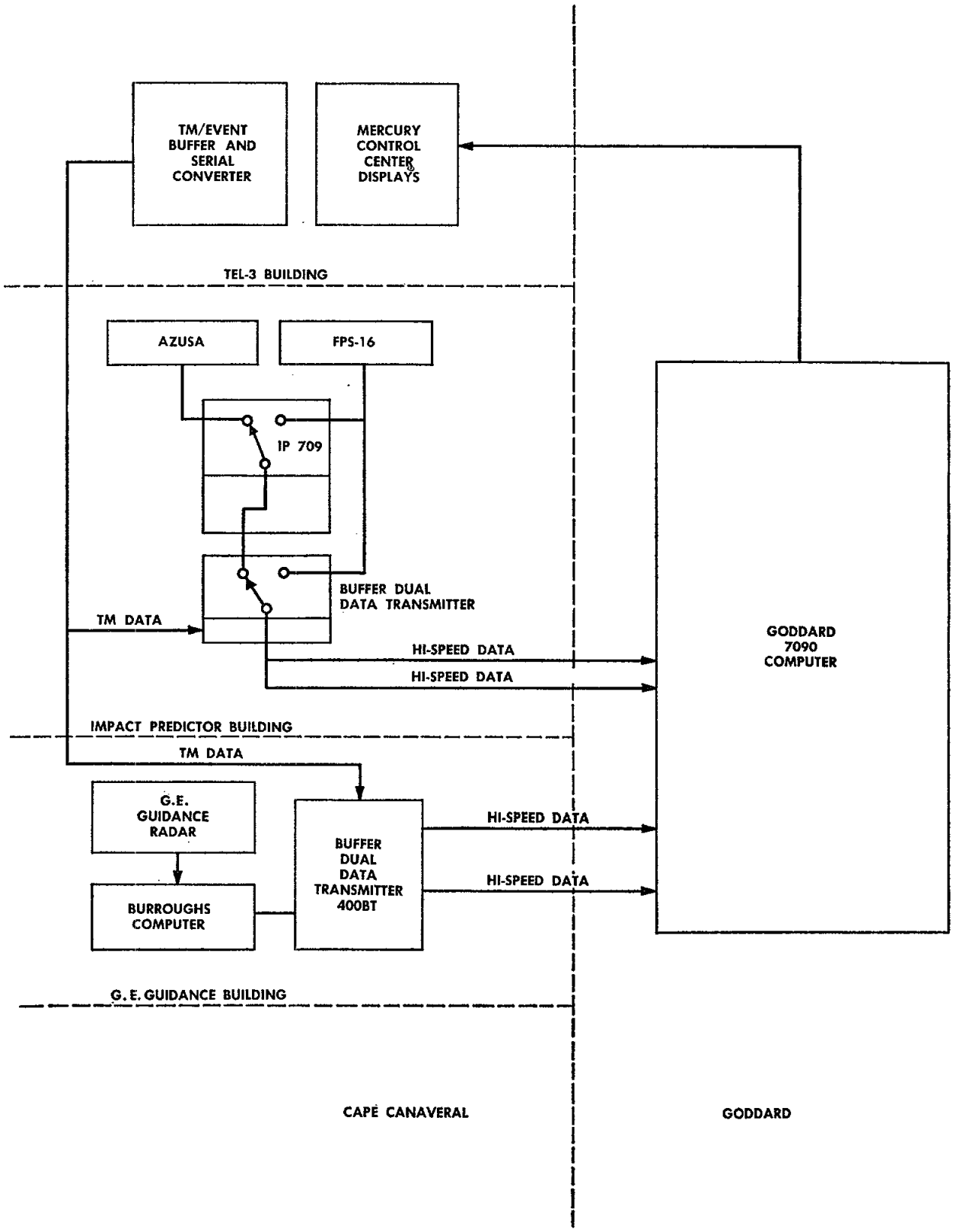


FIGURE 2-4. RADAR DATA PROCESSING — CAPE CANAVERAL

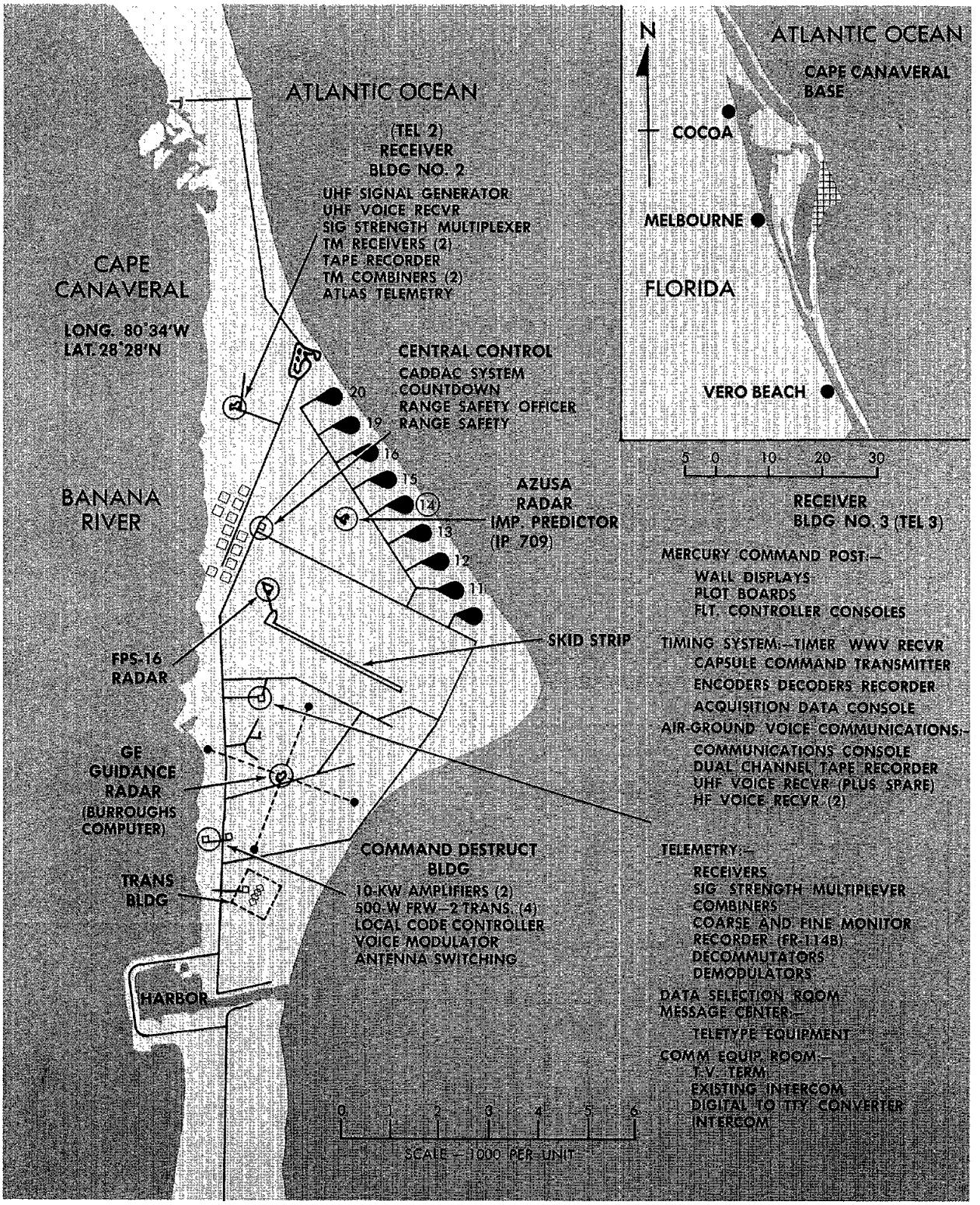


FIGURE 2-5. SITE LOCATION — CAPE CANAVERAL

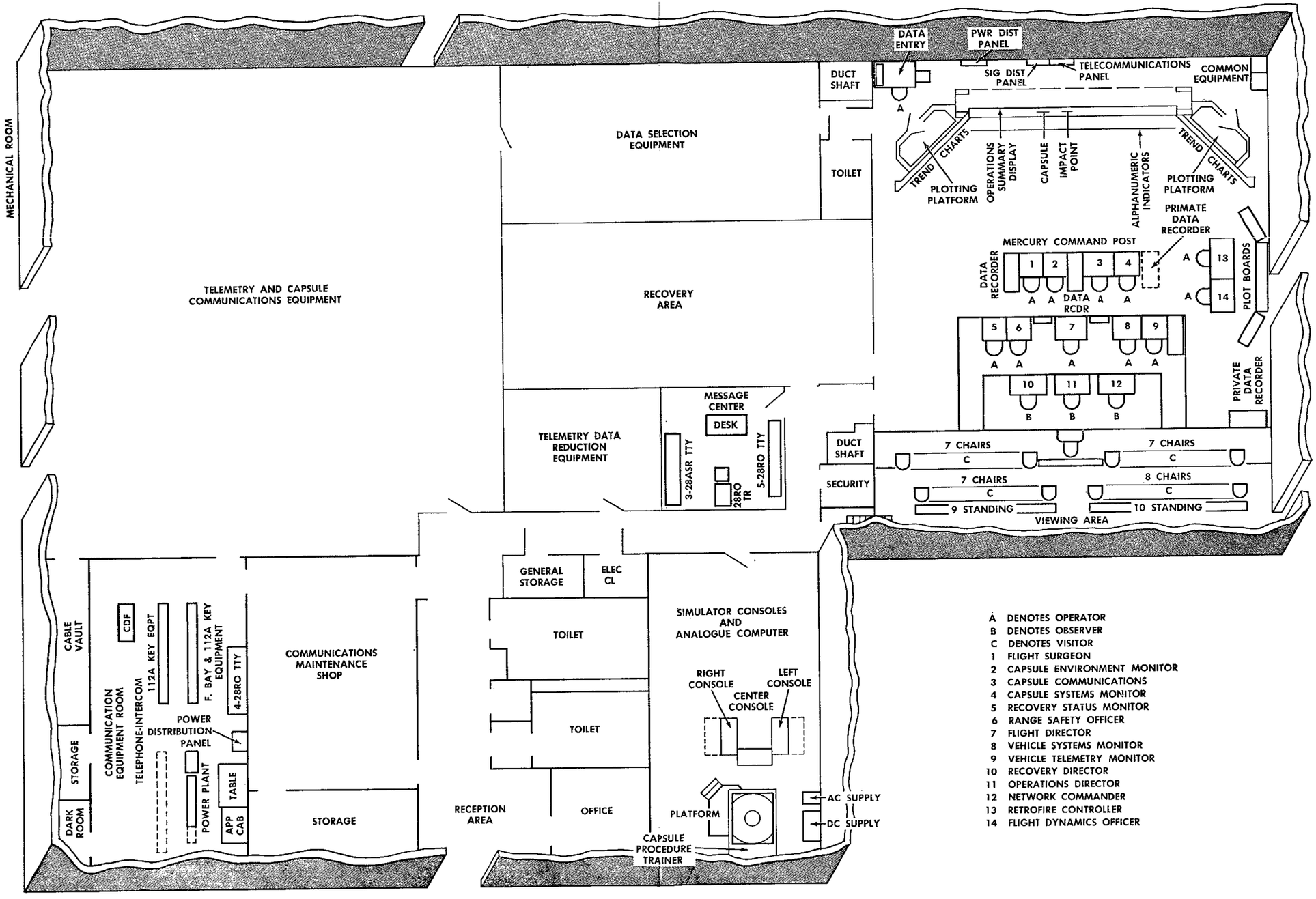
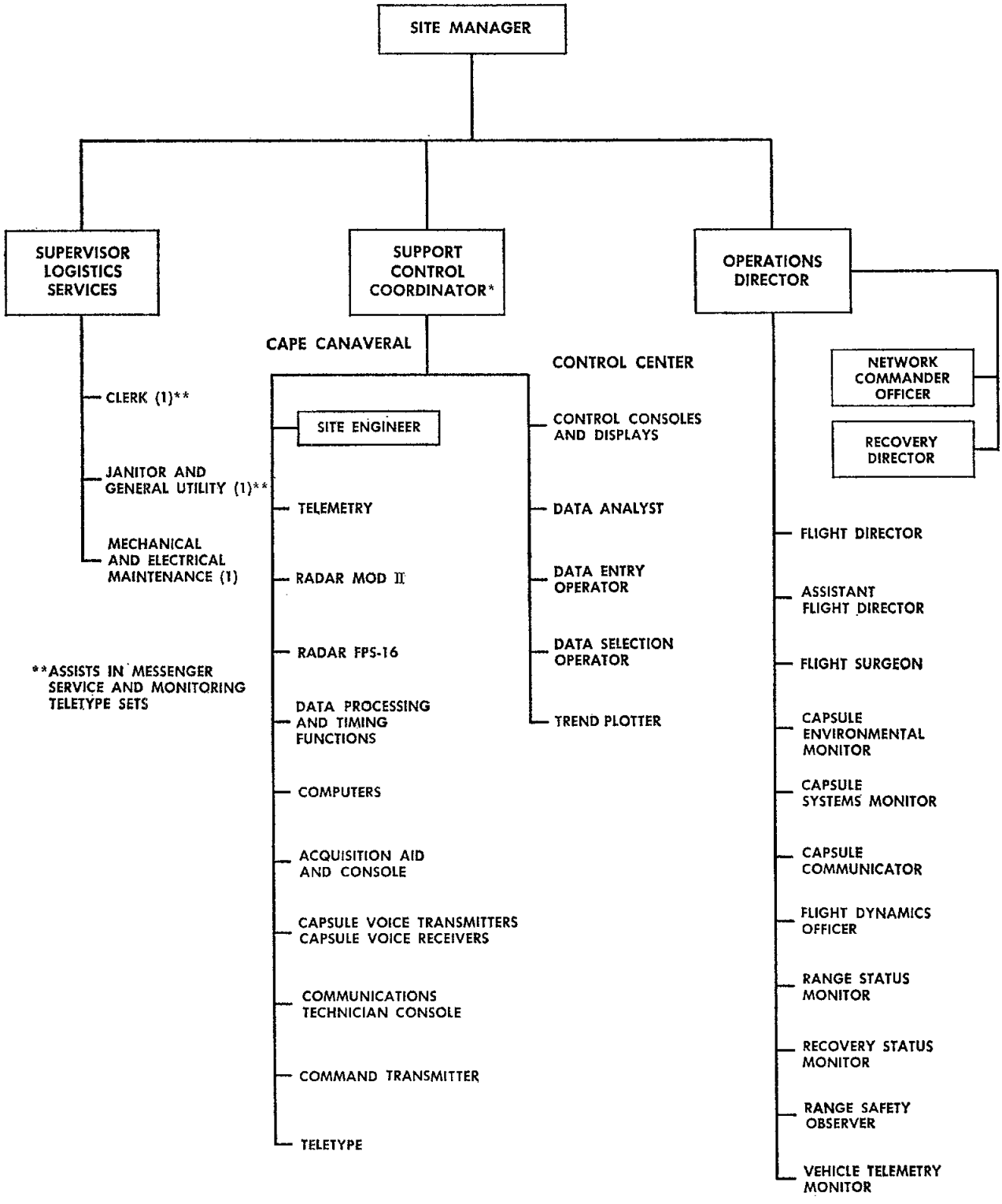


FIGURE 2-6. FLOOR PLAN, TEL-3 BUILDING — CAPE CANAVERAL



*OPERATES TECHNICIANS INTERCOM POSITION

FIGURE 2-7. SITE ADMINISTRATION — CAPE CANAVERAL

Section 3

GRAND BAHAMA AND GRAND TURK ISLANDS

TABLE OF CONTENTS

Paragraph	*Title*	*Page*
3.1	Purpose of the Sites	3-1
3.2	Systems	3-1
	Ground Communications System	3-1
	Intercommunication System	3-1
	Timing System	3-1
	Acquisition System	3-1
	Telemetry System	3-2
	Capsule Communications System	3-2
	Radar System	3-2
3.3	Equipment Allocations	3-3
3.4	Equipment Locations	3-3
	Grand Bahama Island	3-3
	Grand Turk Island	3-3
3.5	Site Administration	3-3
3.6	Geographic and Climatic Data	3-3
	Grand Bahama Island	3-3
	Grand Turk Island	3-4
3.7	Transportation and Communications	3-4
	Grand Bahama Island	3-4
	Grand Turk Island	3-4
3.8	Site Personnel Facilities and Services (Housing, Medical Facilities, Recreational Facilities, Mail Service, Religious Facilities, Clothing and Food)	3-4
	Grand Bahama Island	3-4
	Grand Turk Island	3-5
3.9	Miscellaneous Information — Grand Bahama Island and Grand Turk Island (Money, Passports, Immunization, and Taxes)	3-5

LIST OF ILLUSTRATIONS

Figure	*Title*	*Page*
3-1	Master Functional Block Diagram — Grand Bahama Island	3-7
3-2	Master Functional Block Diagram — Grand Turk Island	3-8
3-3	Transmit and Receive Antenna System — Grand Bahama Island and Grand Turk Island	3-9
3-4	Functional Block Diagram, Acquisition Aid Equipment—Grand Bahama Island and Grand Turk Island	3-11
3-5	Functional Block Diagram, Telemetry System — Grand Bahama Island and Grand Turk Island	3-13
3-6	Functional Block Diagram, Air-Ground Communications — Grand Bahama Island and Grand Turk Island	3-14
3-7	Area Map—Bahama Islands	3-15
3-8	Area Map—Grand Bahama Island	3-16
3-9	Transmitter Site—Grand Bahama Island	3-17
3-10	Receiver Building — Grand Bahama Island	3-18
3-11	Floor Plan, Telemetry Area — Grand Bahama Island	3-19
3-12	Floor Plan, Transmitter Area— Grand Bahama Island	3-20
3-13	Area Map—Grand Turk Island	3-21
3-14	Transmitter Area—Grand Turk Island	3-22
3-15	Receiver Area—Grand Turk Island	3-23
3-16	Floor Plan, Telemetry Area— Grand Turk Island	3-24
3-17	Floor Plan, Transmitter Area— Grand Turk Island	3-25
3-18	Site Administration—Grand Bahama Island and Grand Turk Island	3-27

LIST OF TABLES

Table	*Title*	*Page*
3-1	Major Equipments — Grand Bahama Island and Grand Turk Island	3-3

SECTION 3. GRAND BAHAMA ISLAND AND GRAND TURK ISLAND

3.1 PURPOSE OF THE SITES

In addition to the functions and systems noted in Figure 1-1 these sites are important to Project Mercury for the following reasons.

a. The geographical location of Grand Bahama Island (GBI) makes this site a vital link in the launch phase of the missile because of look-angle problems and associated capsule antenna patterns.

b. Capsule impact will occur in the Atlantic Ocean in the vicinity of Grand Turk Island (GTI). This site is needed to provide coverage during the final phase of reentry when altitude limits the range of other sites.

Communications with Mercury Control Center (MCC) are by the existing submarine cable carrier system.

3.2 SYSTEMS

See Figure 3-1 for a master functional block diagram of the GBI instrumentation. See Figure 3-2 for a master functional block diagram of the GTI instrumentation.

3.2.1 Ground Communications System

Communications with MCC are by way of the existing submarine cable system. A telephone system allows the technician at the communications technician console to perform the following functions:

a. Communicate up-range to Cape Canaveral;

b. Communicate with the capsule directly from the console in case of line failure;

c. Monitor air-ground communications passing through the console;

d. Split the line for communication with either the MCC or the capsule.

The same telephone equipment is supplied for both sites. The cable is routed from Canaveral to GTI by way of GBI. Connection to existing cable facilities is made through an appropriate line termination and is line amplified.

3.2.2 Intercommunication System

Refer to the Project Mercury ground communications plan for the appropriate drawings.

3.2.3 Timing System

Timing information is supplied to both sites in decimal serial data form by Cape Canaveral. This time reference is then retransmitted to Cape Canaveral as a part of the real-time telemetry data.

3.2.4 Acquisition System

See Figures 3-3 and 3-4. An acquisition data console, located in the Receiver Building at both sites, provides the Acquisition Data Console Operator with:

a. The azimuth and elevation of the receiving and transmitting antennas;

b. Received signal strength indications from the two telemetry receivers.

The Acquisition Data Console Operator can control site antenna pointing by manual operation. Two handwheels on the console control the elevation and azimuth respectively, of all site antennas directed by the console. Console indicators show the azimuth and elevation coordinates selected by the handwheels.

Radars, present at these sites, are not connected to the Mercury acquisition system, necessitating use of the manual mode for Mercury operations.

Acquisition information, in terms of azimuth and elevation coordinates, is received at both sites by the console operator who points the site antennas, using the manual mode. Signal strength indications are then observed to assist in manually slewing the antennas during the capsule pass.

Synchro line amplifiers are added to the system between the console and transmitter antenna at GTI because the distance exceeds 1.5 miles. Synchro remoting equipment is necessary at GBI because of distances greater than those at GTI.

3.2.5 Telemetry System

The two telemetry receiver outputs and signal strength indications are frequency multiplexed and are transmitted to the MCC via the submarine cable carrier system (Figure 3-5). At MCC, the best signal source, as determined by the signal strength indications from the two TLM receivers, is selected for processing.

Switching facilities, available at GBI, permit either local or remote (GTI) telemetry transmission to reach MCC by the submarine cable.

3.2.6 Capsule Communications System

The air-to-ground communications facilities at these sites (Figure 3-6) consist of high-frequency (HF) and ultra-high-frequency (UHF) amplitude modulation (AM) voice receiving and transmitting equipment housed in the respective receiving and transmitter buildings. Antenna positioning is controlled by the Acquisition Data Console Operator as discussed in paragraph 3.2.4, or locally at the antenna servo rack.

Communications receiver selection is controlled from Cape Canaveral, utilizing the existing supervisory control system. Similarly, transmitter selection and transmitter keying is controlled at the MCC at Cape Canaveral by the Communications Technician.

GBI and GTI share existing cable facilities. Switching requirements are provided at GBI for selection of either GTI or GBI communications transmission to Cape Canaveral.

Greater reliability in communications reception is obtained by using two receiving systems, one system operating in the UHF region and the other system operating in the HF region. Two receivers are provided for each system. The second receiver in each system serves as a standby unit. The Communications Technician at MCC selects the communication system at either GBI or at GTI, selection being determined by quality of reception. The technician at MCC cannot select between UHF and HF receivers at these sites. Local control at GBI and GTI determines whether UHF or HF equipment is used at these sites, selection being determined by the quality of reception.

Similarly, there are two HF and two UHF transmitters, selection and utilization of which is determined by the Communications Technician at the Canaveral communications technician console. Selection of the transmitting equipment is accomplished by the down-range supervisory control system.

3.2.7 Radar System

The radar system at Grand Bahama Island consists of an FPS-16 C-band radar. Two MOD II radars are also available on the island, but will not be used in the Mercury project. S-band radar is not used at Grand Turk Island although present as part of the sites instrumentation.

The Grand Bahama radar installation is operated in accordance with its usual practices. The input to the Cape Canaveral computer is shown in the Cape Canaveral functional block diagram, Figure 2-1.

The narrow beamwidth of the FPS-16 antenna aids in providing precise tracking information to MCC over a range of approximately 500 miles. The radar is capable of beacon or skin tracking. Three possible modes of operation are automatic, acquisition, and manual.

The automatic mode is a self-contained capability permitting the radar to track automatically in range, azimuth, and elevation.

The acquisition mode requires target-position signals to the radar angle tracking section from an external source. The source in this case is the Central Analog Data Distributing and Computing System (CADDAC).

In the manual mode, the antenna is positioned through a manually controlled synchro system by manipulation of the MANUAL ELEVATION and MANUAL AZIMUTH handwheels on the range indicator panel of the operator console.

A digital data processing system is incorporated into the FPS-16 radar and converts range, azimuth, and elevation coordinate information simultaneously to digital form. The three-coordinate digital data is transmitted through the digital data system to an external system where it is converted for teletype transmission to Canaveral. Radar data is also displayed visually on numerical indicators.

TABLE 3-1

MAJOR EQUIPMENTS — GRAND BAHAMA ISLAND AND GRAND TURK ISLAND

System	*Equipment*	*Type or Model*	*Supplied By*
Acquisition	Active Acquisition Aid		Cubic
	Acquisition Data Console		Bendix Radio
Radar*	C-band	FPS-16	RCA
Telemetry	Preamplifier	PR-203	Nems-Clarke
	Receiver	1412	Nems-Clarke
	Receiver	1434	Nems-Clarke
	Discriminator, Dual-Channel	TDA-102	Bendix
Air-Ground Communi-cations	HF Transmitter (2 at Grand Turk Island)	CS2029	Gates
	HF Receiver (2)	R-390A/GR	Collins
	UHF Transmitter consisting of:	GRT-3	
	UHF Transmitter	T-282/GR	Radio Receptor
	Modulator Power Supply	MD-141A/GR	Radio Receptor
	UHF Receiver (2)	278B/GR	Collins
	Power Modulation Monitor	SG41.1 & SG41.2	M. C. Jones
	Tape Recorder	P-75BACX	Magnacord
	Sidetone Line Amplifier	BXR-LA 200	Bendix Radio
	Microphone Amplifier (2 at Grand Turk Island)	M-5167	Gates
	Preamplifier	PR-2035	Nems-Clarke
	Communications Technician Console	BXR-CTC 500	

* Grand Turk Island not equipped with radar for Project Mercury

3.3 EQUIPMENT ALLOCATIONS

See Table 3-1 for a list of the major equipments at the sites.

3.4 EQUIPMENT LOCATIONS

3.4.1 Grand Bahama Island

Grand Bahama equipment locations appear in Figures 3-8 through 3-12.

3.4.2 Grand Turk Island

Grand Turk equipment locations appear in Figures 3-13 through 3-17.

3.5 SITE ADMINISTRATION

This appears in chart form in Figure 3-18.

3.6 GEOGRAPHIC AND CLIMATIC DATA

3.6.1 Grand Bahama Island

The Bahamas consist of a scatterd archipelago of some 700 islands (Figure 3-7), of which 20 are inhabited covering an area nearly 800 miles in length. GBI is at latitude 26°36′ N, longitude 78°25′ W. The site is located approximately 22 miles east of the town of Freeport and is described as a large construction camp with one general store. GBI is a coral island with a maximum elevation of 25 feet and semitropical vegetation. The population in 1953 was 4,095.

The average winter temperature is about 70° F., the winter rainfall is slight, and cool breezes prevail. In July, August, and September, the temperature ranges from 75° F. to 90° F. Because the diurnal change of temperature is so small, some people find the humidity during the summer months trying. Rainfall averages 50 inches per annum, falling chiefly during June and October.

Health conditions on the island are good. No special precautions are deemed necessary.

3.6.2 Grand Turk Island

Grand Turk is a member of the Turks and Caicos Islands. This group is located in the British West Indies and is geographically a part of the Bahamas but politically a dependency of Jamaica. The soil is limestone and coral. The area is about 166 square miles, and the population is about 6,700. The temperature ranges from a maximum of 86° F in August to a minimum of 71° F in January. The mean temperature is 80° F and the humidity is 65 to 85 percent, but because of the prevailing trade winds the climate is not oppressive. The annual rainfall is 15.33 inches. The water table is 10 feet mean sea level. There are occasional hurricanes, typhoons, and monsoons. During these periods, winds may vary between 70-90 miles per hour, although maximum velocities of 150 miles per hour have occurred.

Salt raking is the staple industry. Conchs and crayfish are also exported.

Grand Turk, the seat of government, is an important cable junction, with cables to Jamaica, Bermuda, and Barbados. There is frequent shipping and air service to Kingston, Jamaica. The site is located approximately 3 miles from Cockburn Town (estimated population less than 1,000).

3.7 TRANSPORTATION AND COMMUNICATIONS

3.7.1 Grand Bahama Island

The U.S. Government has its own docks which service the range station. Commercial shipping companies operate vessels to this island out of Port Canaveral, Florida, making cargo runs approximately every 5 days.

There is a 6300-foot asphalt runway, located approximately ¾ mile from the site. This runway can accommodate a C-124 Globemaster. Two other runways on GBI are a 2800-foot coral airstrip at Marco City and a 2600-foot asphalt airstrip at West End.

GBI has good two-lane secondary roads on the island and a complete road net of asphalt-paved roads to all range installations.

3.7.2 Grand Turk Island

Grand Turk Island has an airfield with a runway 5043 feet long. There are 500-foot overruns at each end. The coral and asphalt runway is 150 feet wide, with stabilized shoulders 50 feet wide extending the length of the runway, and is capable of handling a C-124. Bahama Airlines schedules one flight per week and landing is limited to Visual Flight Requirements (VFR). The airfield also has a homer beacon identifier operating on a frequency of 232 kc.

Docking facilities are available and are capable of handling landing ship–miscellaneous (LSM) types of vessels operated by the transport group supplying the island.

Secondary asphalt roads connect site buildings and are adequate for handling normal size and weight limits. Vehicles, other than military, are not available, and no railroad facilities exist on GTI.

3.8 SITE PERSONNEL FACILITIES AND SERVICES

3.8.1 Grand Bahama Island

There are no offsite housing facilities. Current base population consists of 6 to 8 range personnel and 270 permanent civilian English-speaking personnel.

Personnel trained in first aid treat minor cases. Major cases are flown to mainland hospital facilities. No dental facilities are available. One general hospital is located in New Providence.

Mail is flown in daily except weekends.

Catholic and Protestant services are held at the airfield.

During the winter fairly warm clothing is needed. In the summer, lightweight washable clothes are worn. It is advisable to bring an adequate supply inasmuch as most items are imported; costs are quite high and supplies are limited.

3.8.2 Grand Turk Island

No offsite housing facilities are available.

No medical facilities are available.

Boating, fishing, and swimming are the primary sources of entertainment.

All mail is handled by the range logistics group.

Lightweight washable clothing is sufficient.

3.9 MISCELLANEOUS INFORMATION — GRAND BAHAMA ISLAND AND GRAND TURK ISLAND

The currency of the colony is sterling, but U. S. currency is often used. As of March 1, 1960, the pound (£) exchanged for $2.80. The shilling (s) equals approximately 14 cents.

Passports or visas are not required for U. S. citizens who possess a return ticket and sufficient living funds.

It is essential to hold a certificate of vaccination against small pox issued within the last three years.

There is no income tax or tax on undeveloped property, but there is a probate duty of 4 percent on personal effects within the colony.

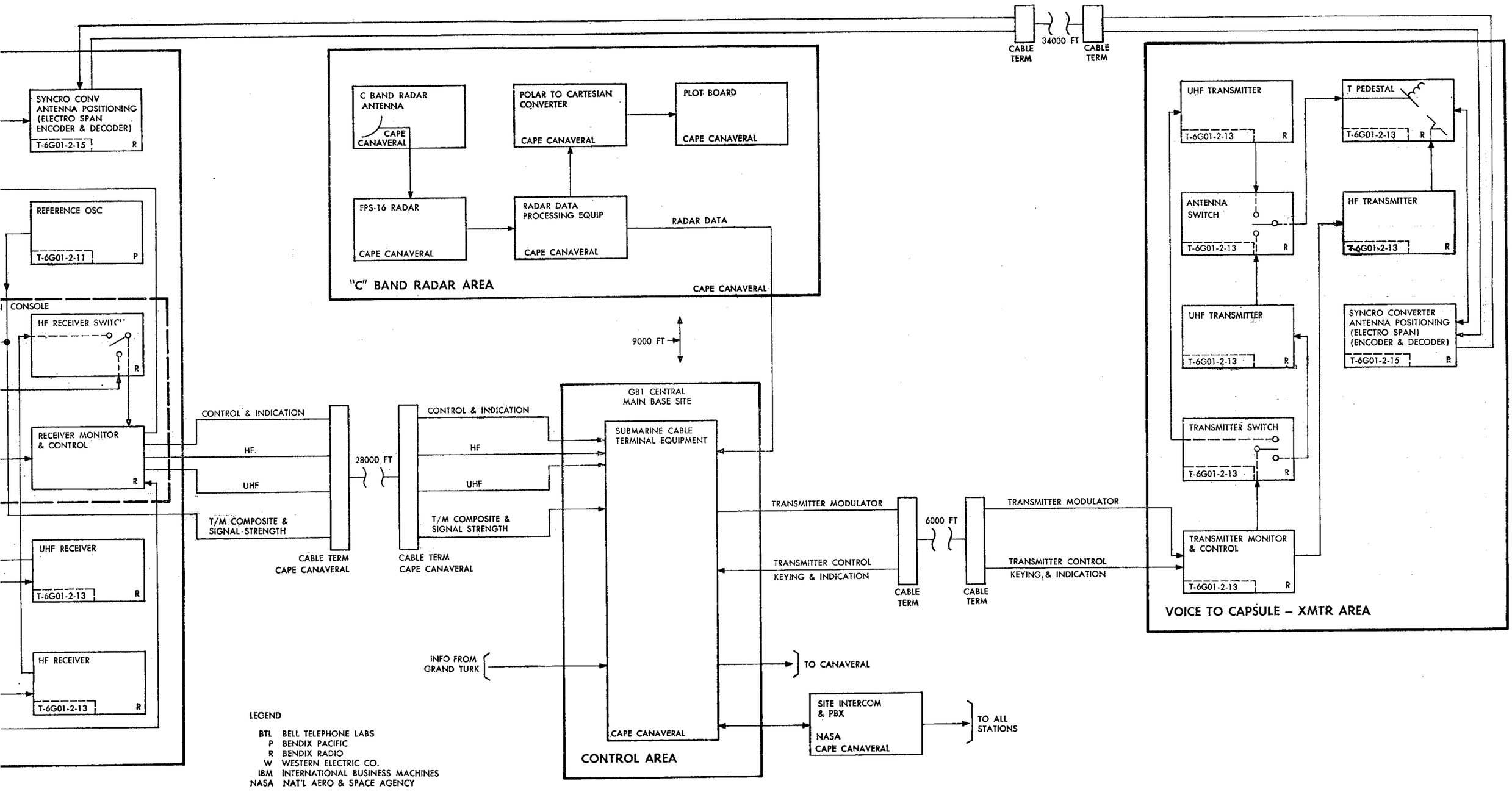


FIGURE 3-1. MASTER FUNCTIONAL BLOCK DIAGRAM — GRAND BAHAMA ISLAND

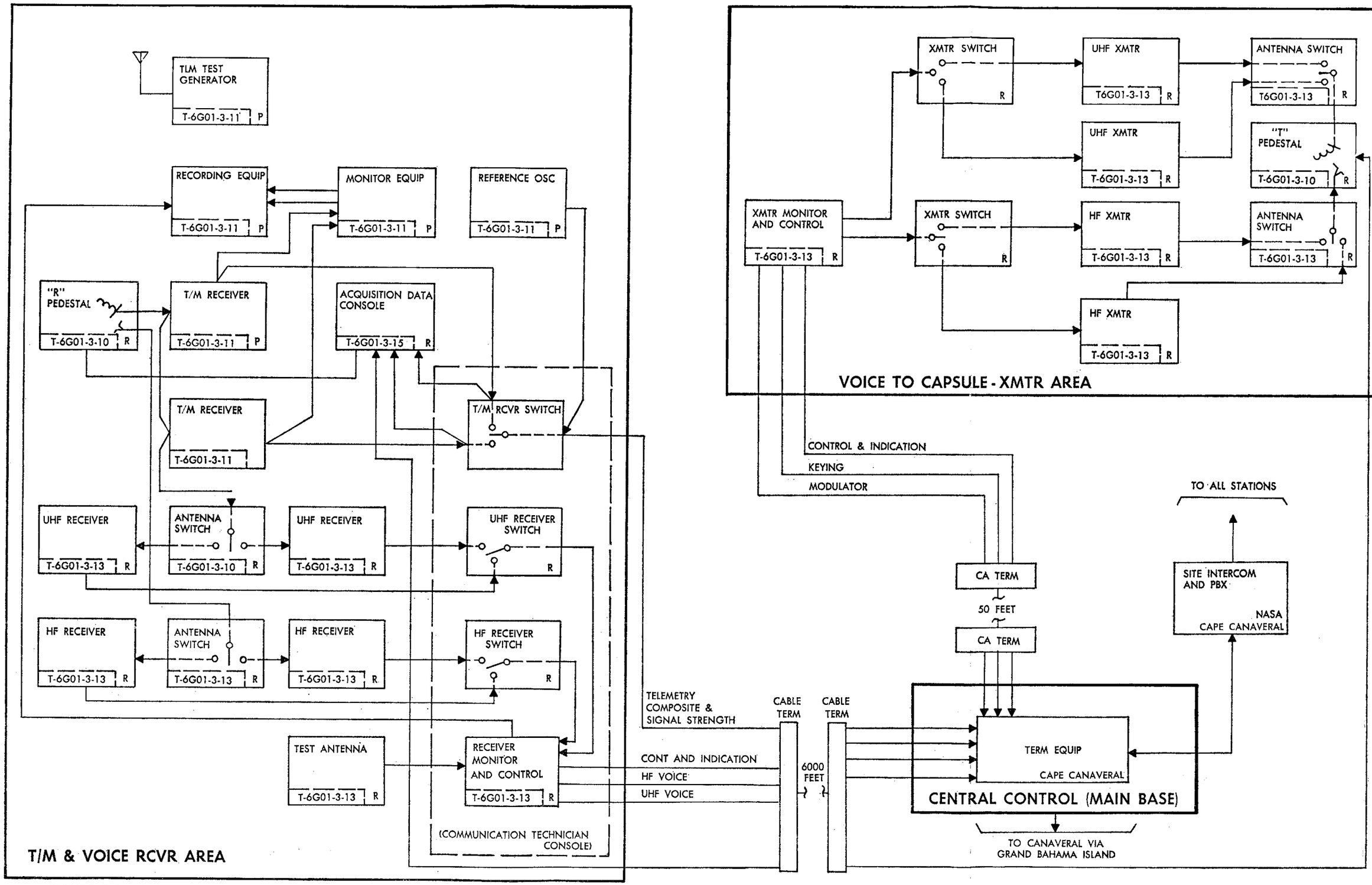


FIGURE 3-2. MASTER FUNCTIONAL BLOCK DIAGRAM — GRAND TURK ISLAND

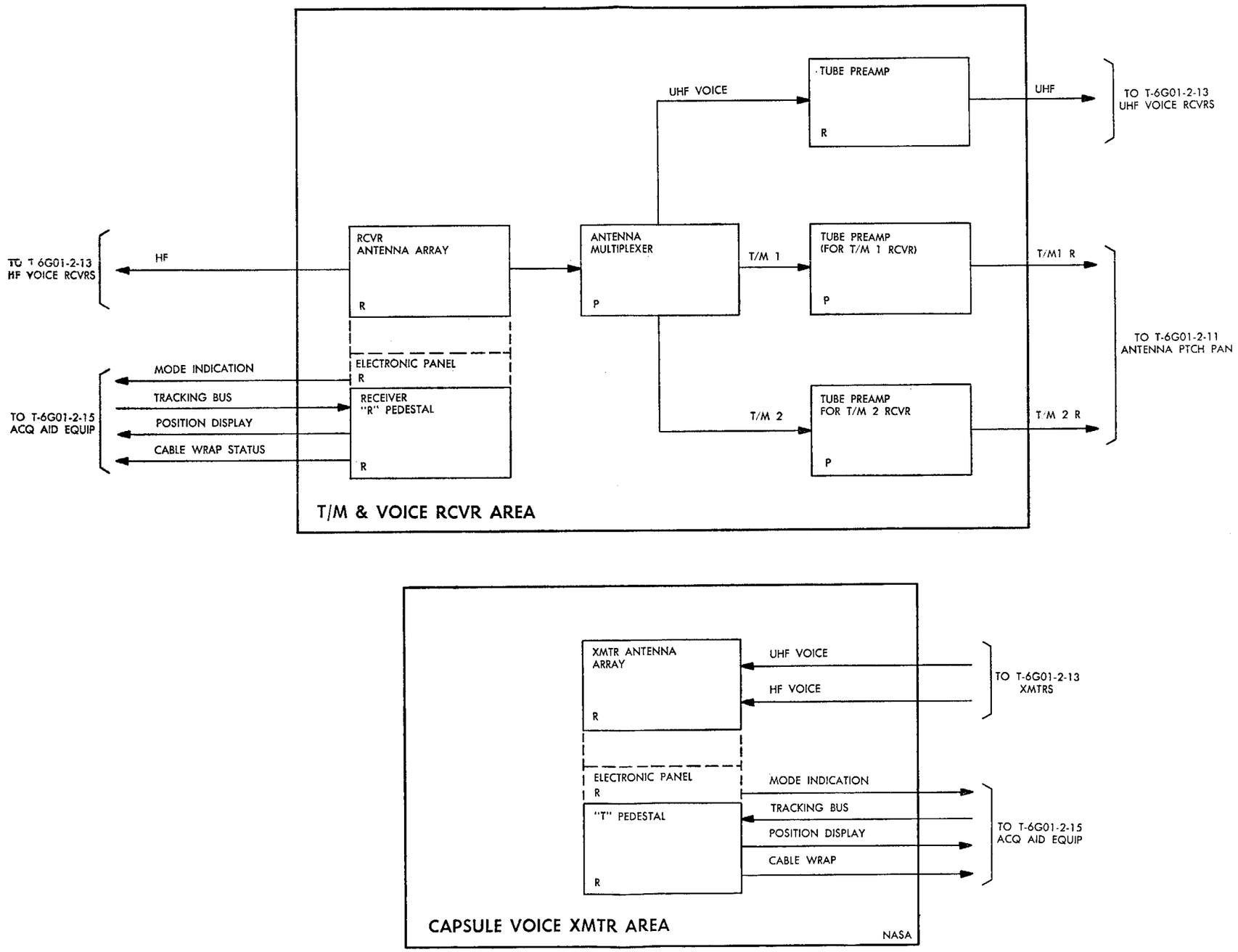


FIGURE 3-3. TRANSMIT AND RECEIVE ANTENNA SYSTEM — GRAND BAHAMA ISLAND AND GRAND TURK ISLAND

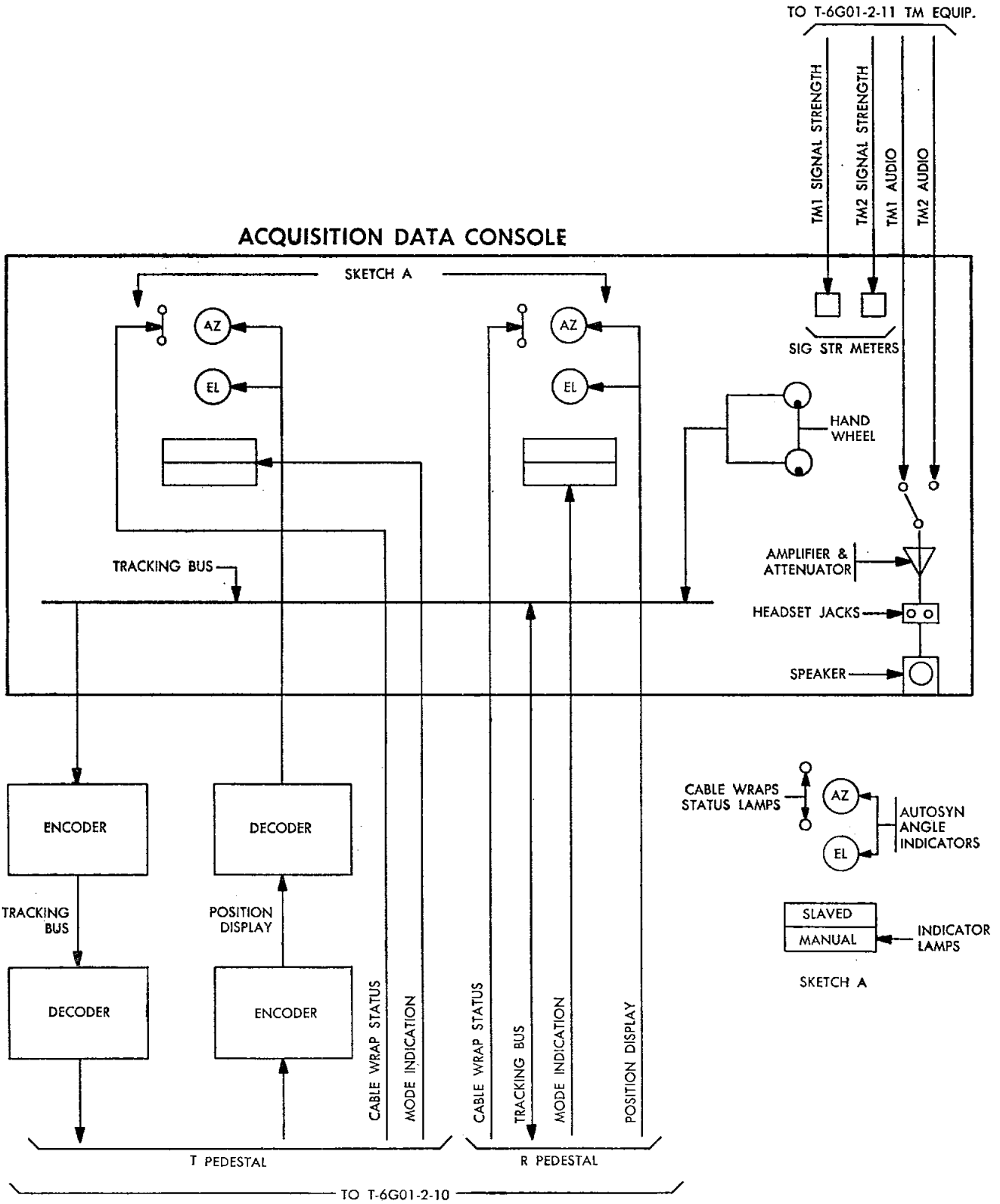


FIGURE 3-4. FUNCTIONAL BLOCK DIAGRAM, ACQUISITION AID EQUIPMENT — GRAND BAHAMA ISLAND AND GRAND TURK ISLAND

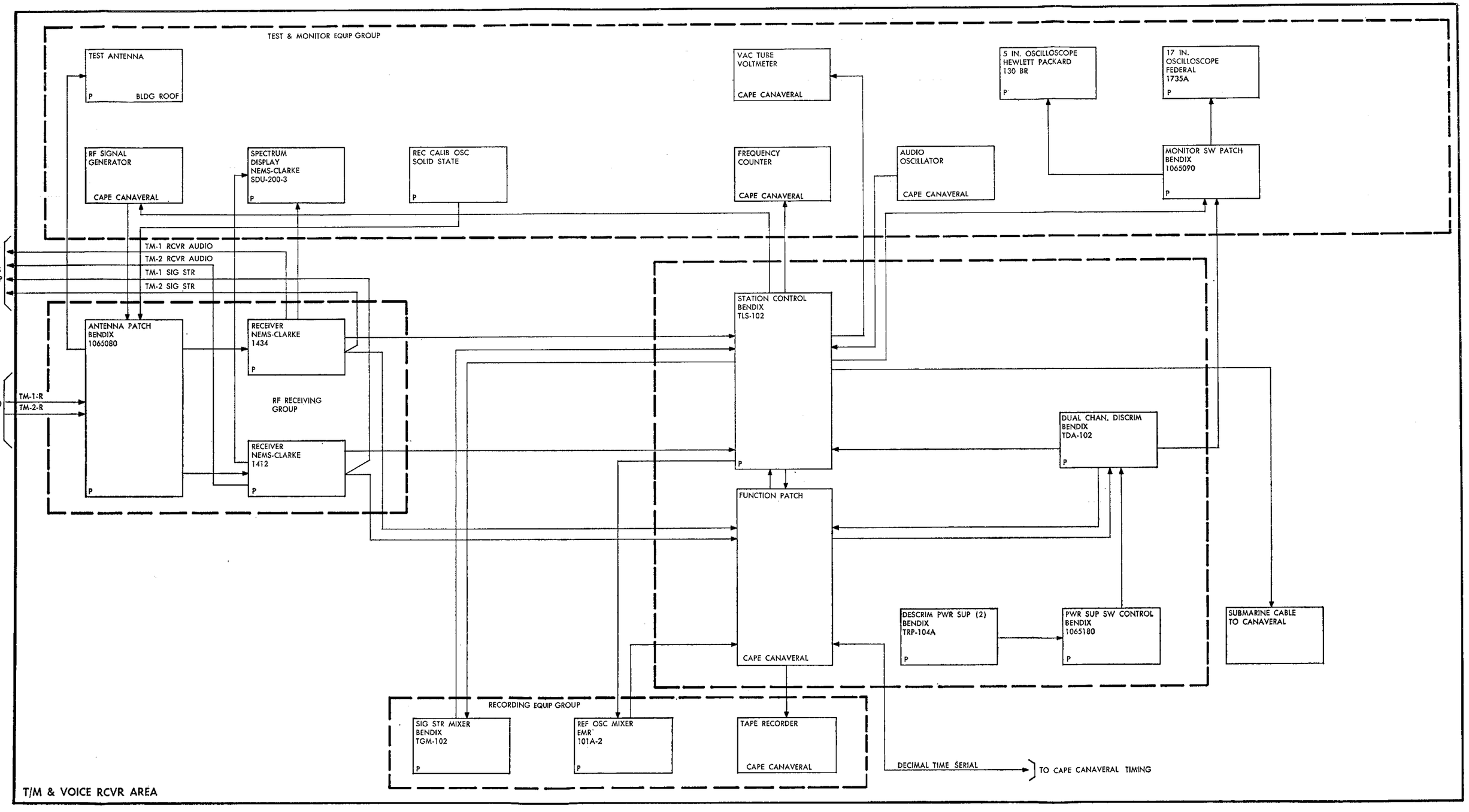


FIGURE 3-5. FUNCTIONAL BLOCK DIAGRAM, TELEMETRY SYSTEM — GRAND BAHAMA ISLAND AND GRAND TURK ISLAND

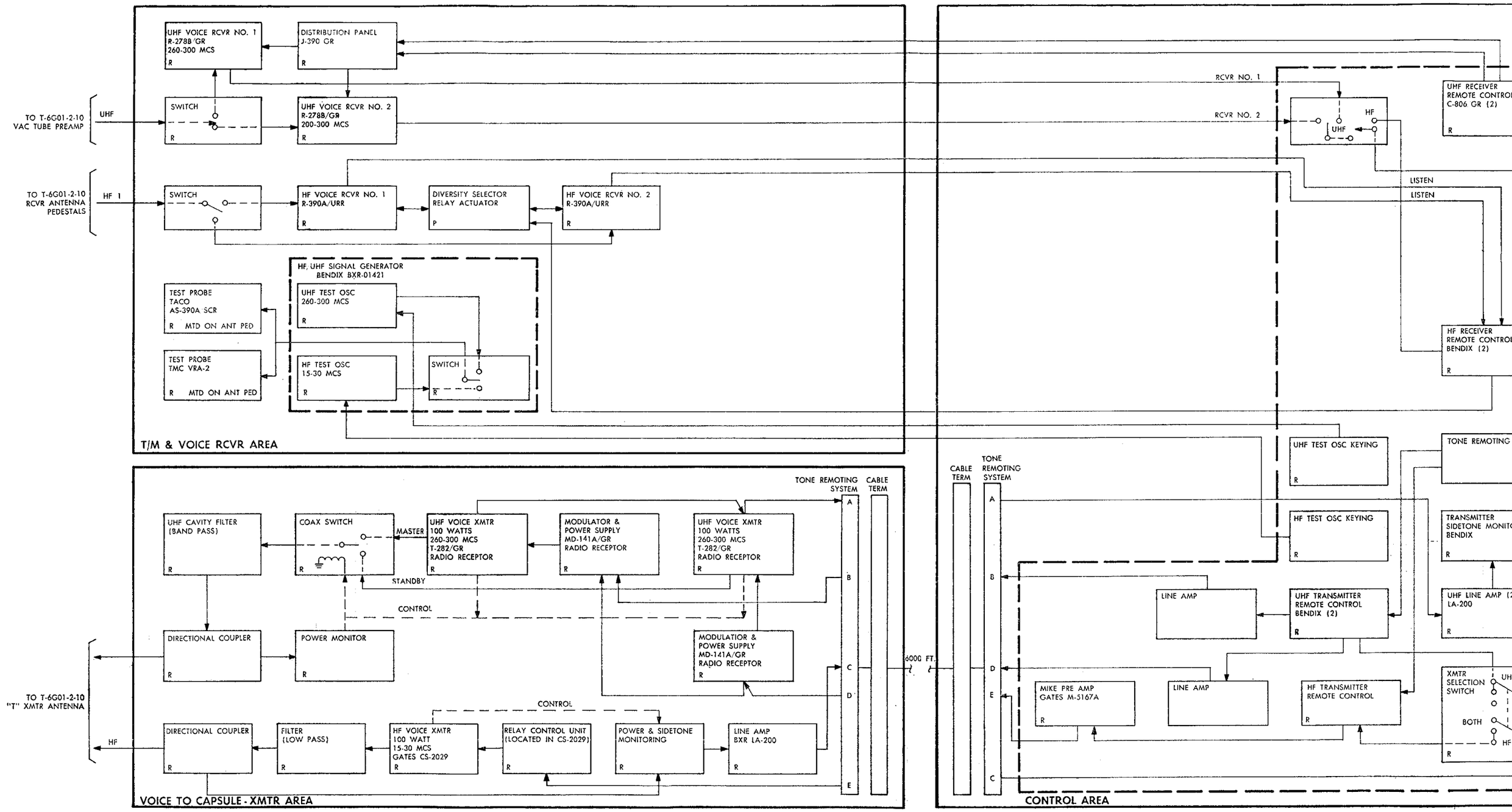


FIGURE 3-6. FUNCTIONAL BLOCK DIAGRAM, AIR-GROUND COMMUNICATIONS — GRAND BAHAMA ISLAND AND GRAND TURK ISLAND

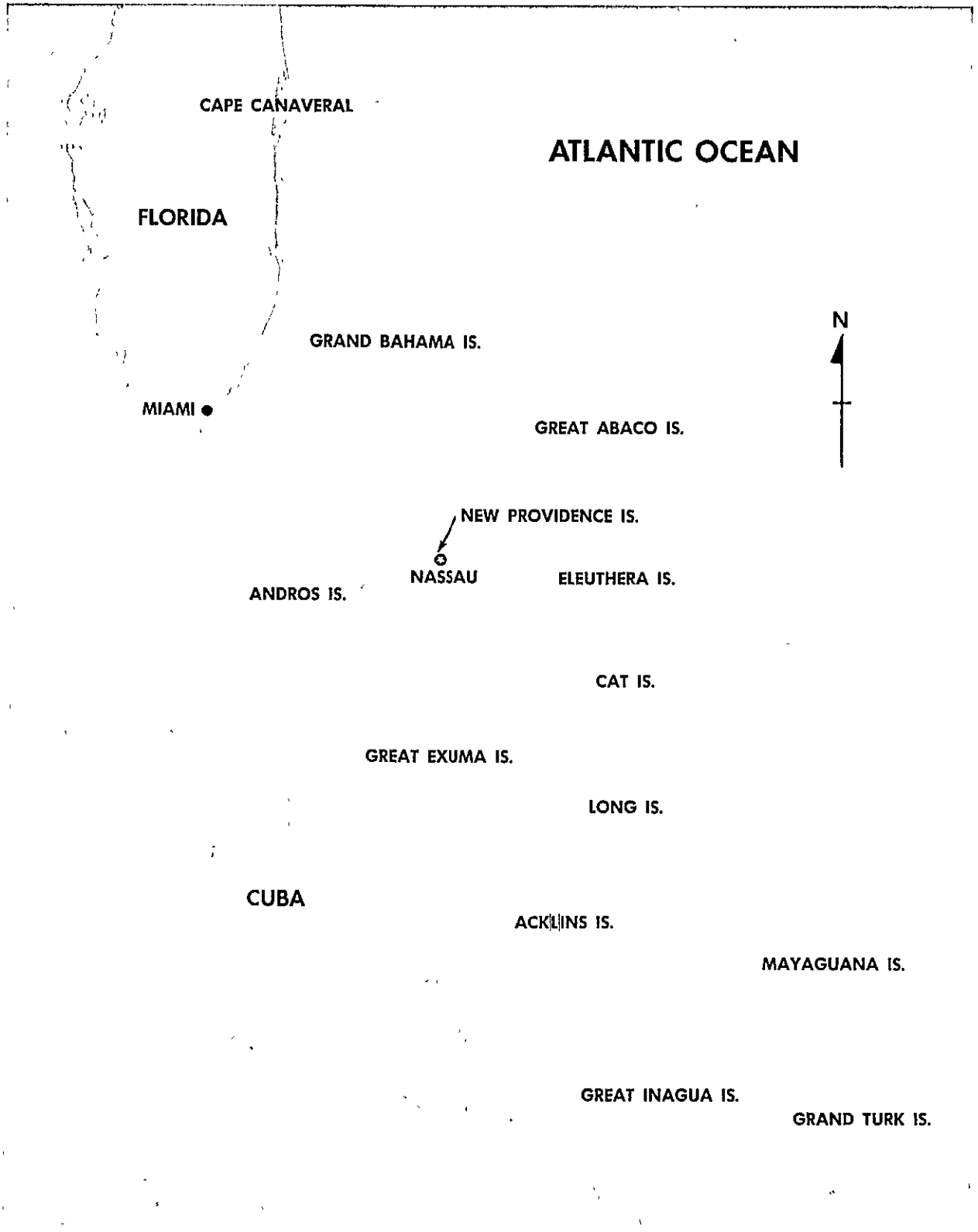


FIGURE 3-7. AREA MAP — GRAND BAHAMA ISLANDS

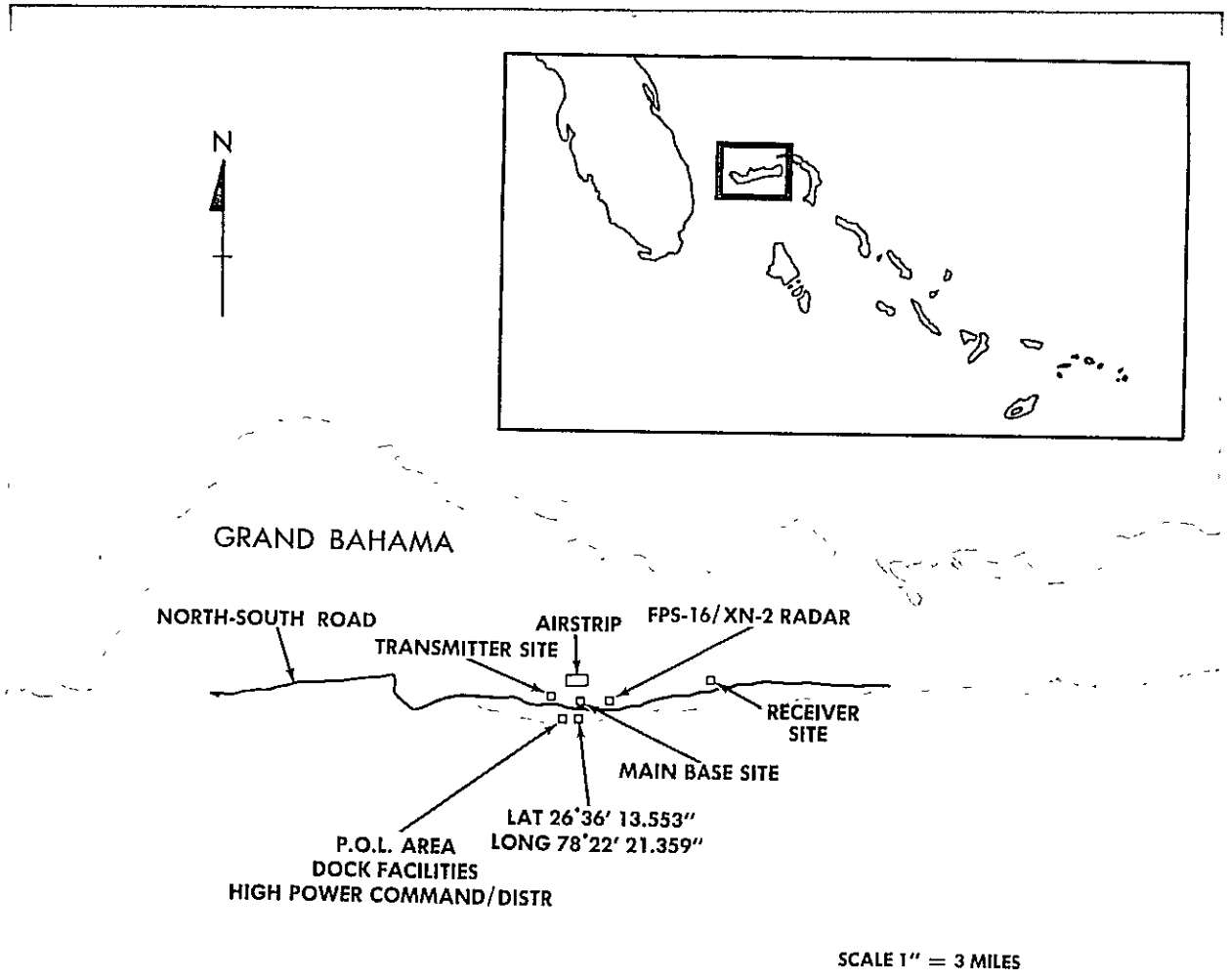


FIGURE 3-8. AREA MAP — GRAND BAHAMA ISLAND

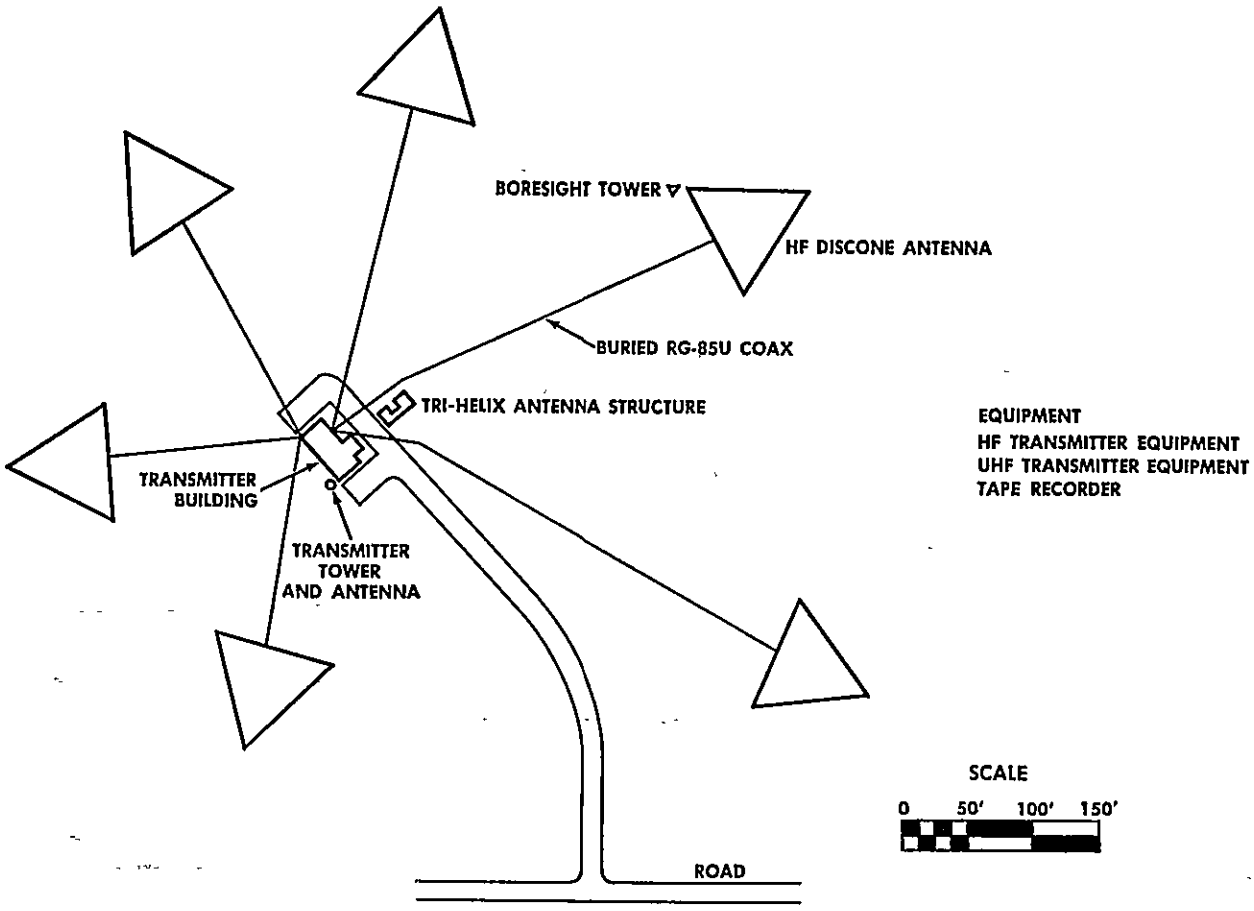


FIGURE 3-9. TRANSMITTER SITE — GRAND BAHAMA ISLAND

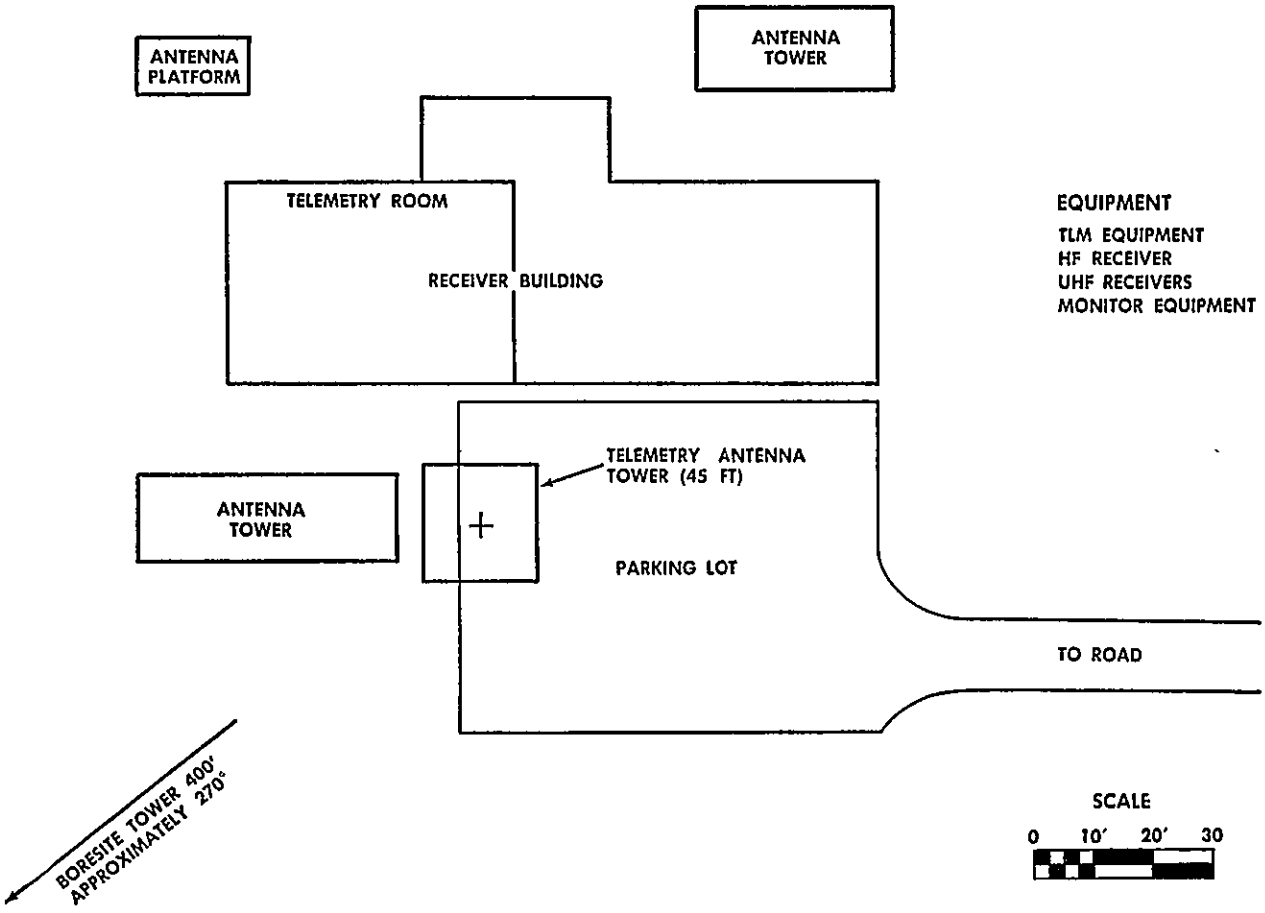


FIGURE 3-10. RECEIVER BUILDING — GRAND BAHAMA ISLAND

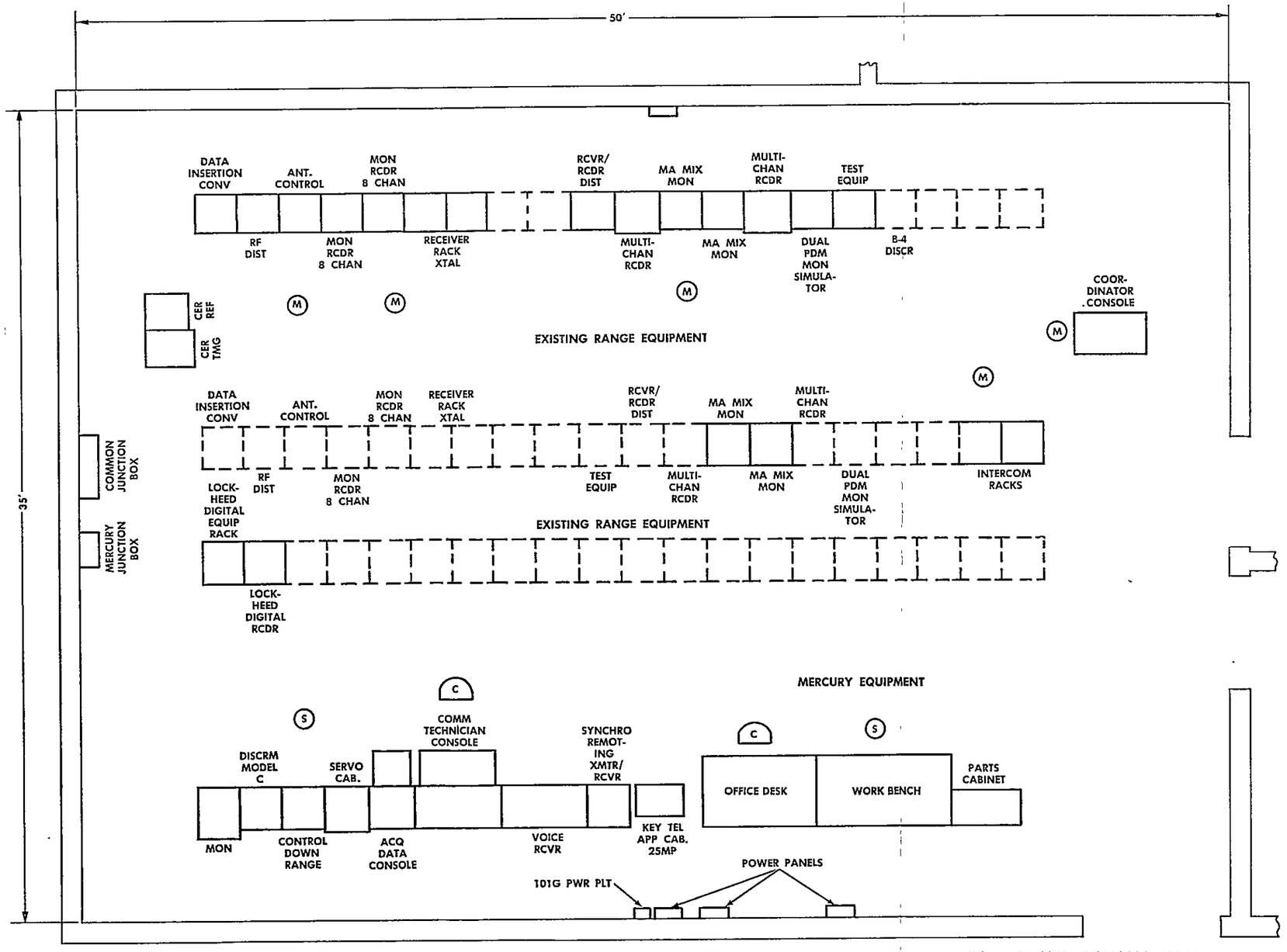


FIGURE 3-11. FLOOR PLAN, TELEMETRY AREA — GRAND BAHAMA ISLAND

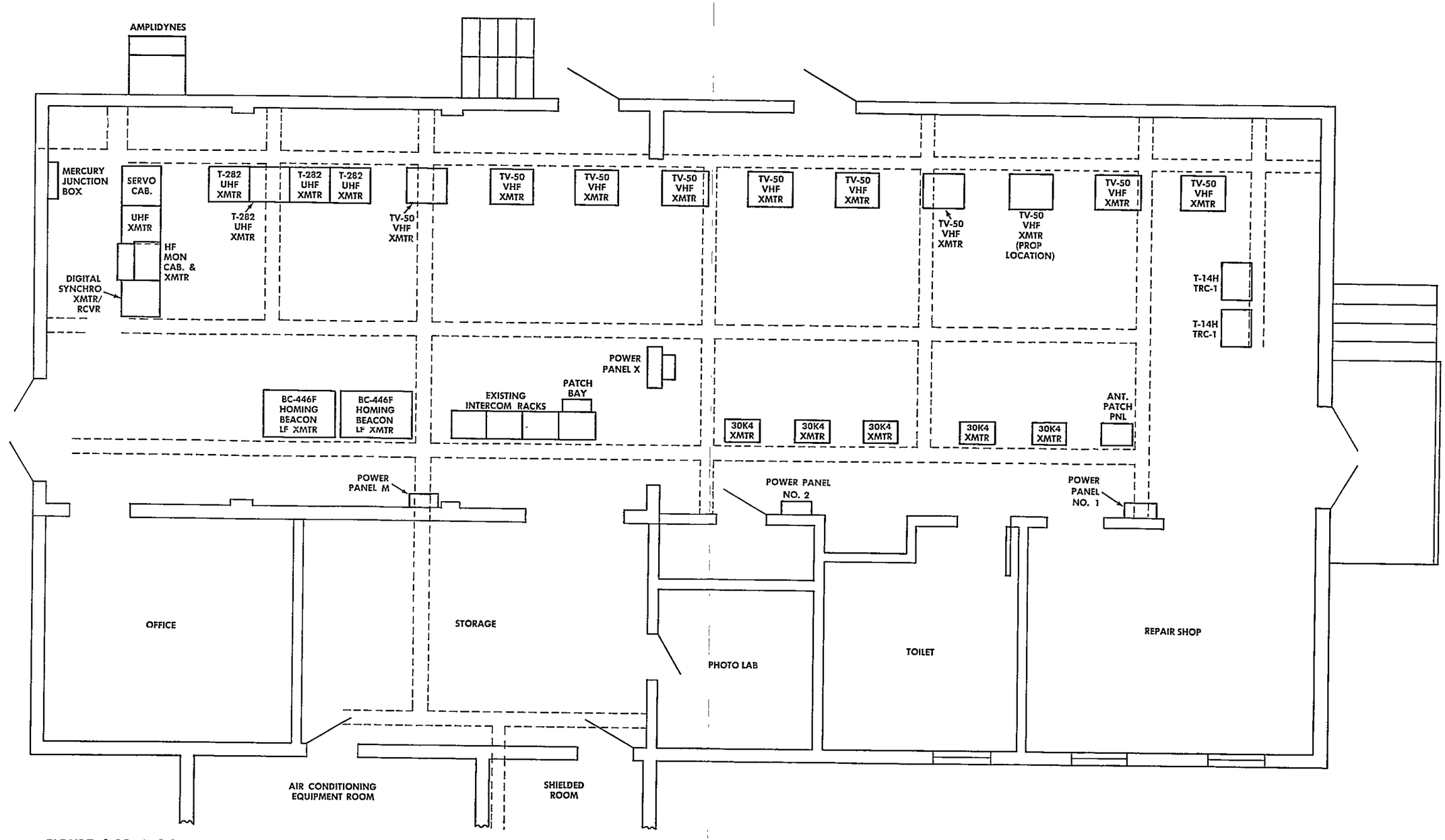


FIGURE 3-12. FLOOR PLAN, TRANSMITTER AREA — GRAND BAHAMA ISLAND

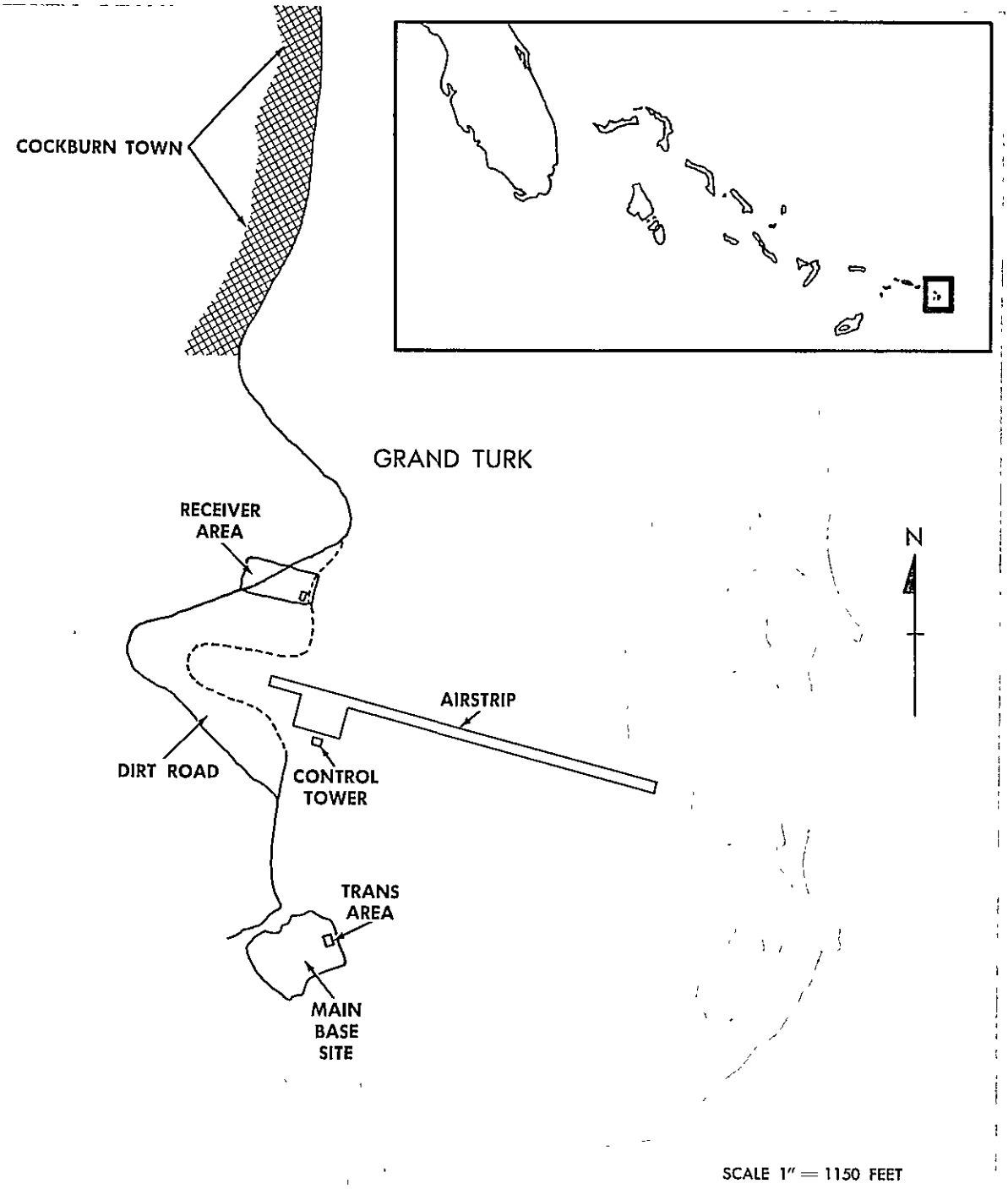


FIGURE 3-13. AREA MAP — GRAND TURK ISLAND

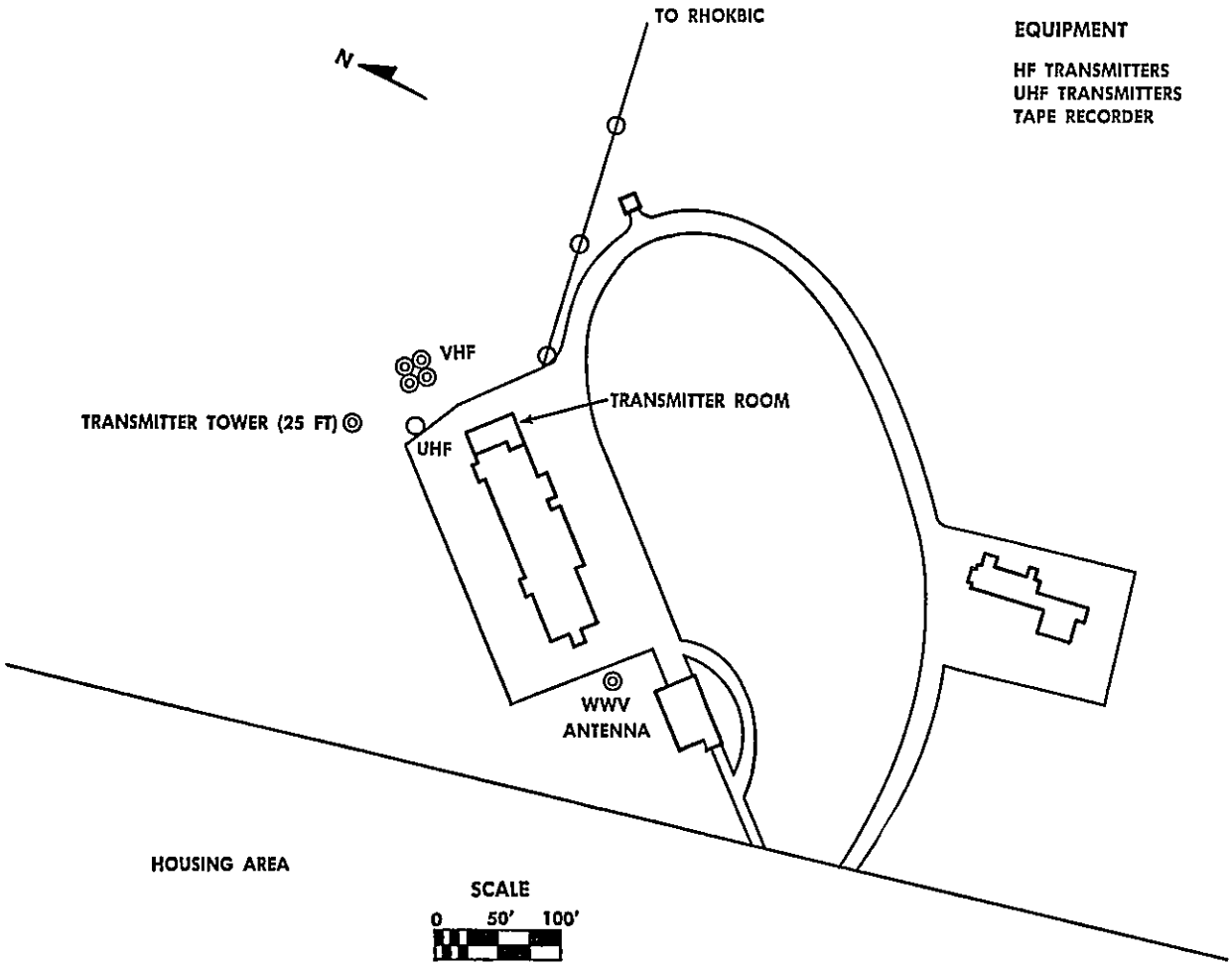


FIGURE 3-14. TRANSMITTER AREA — GRAND TURK ISLAND

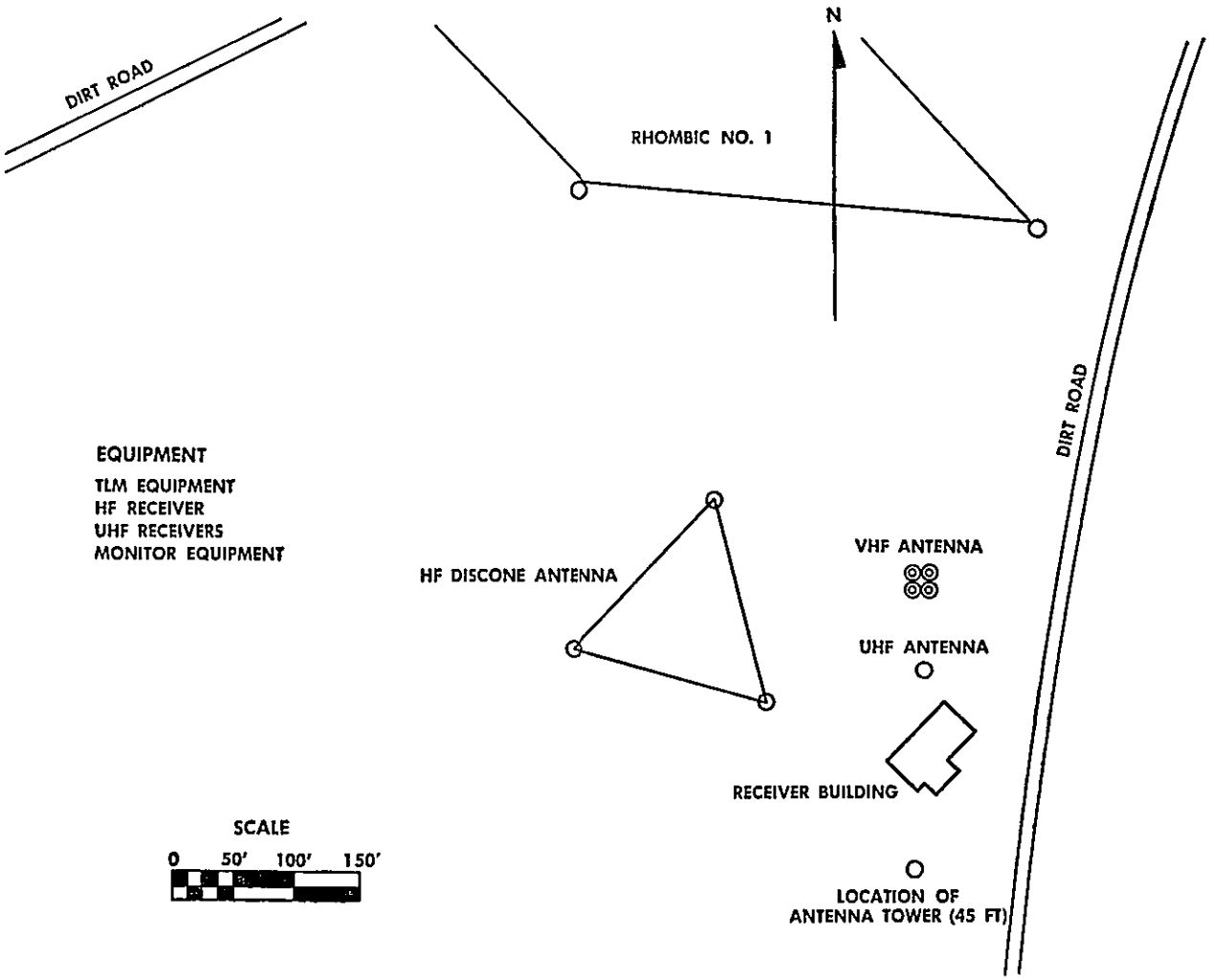


FIGURE 3-15. RECEIVER AREA — GRAND TURK ISLAND

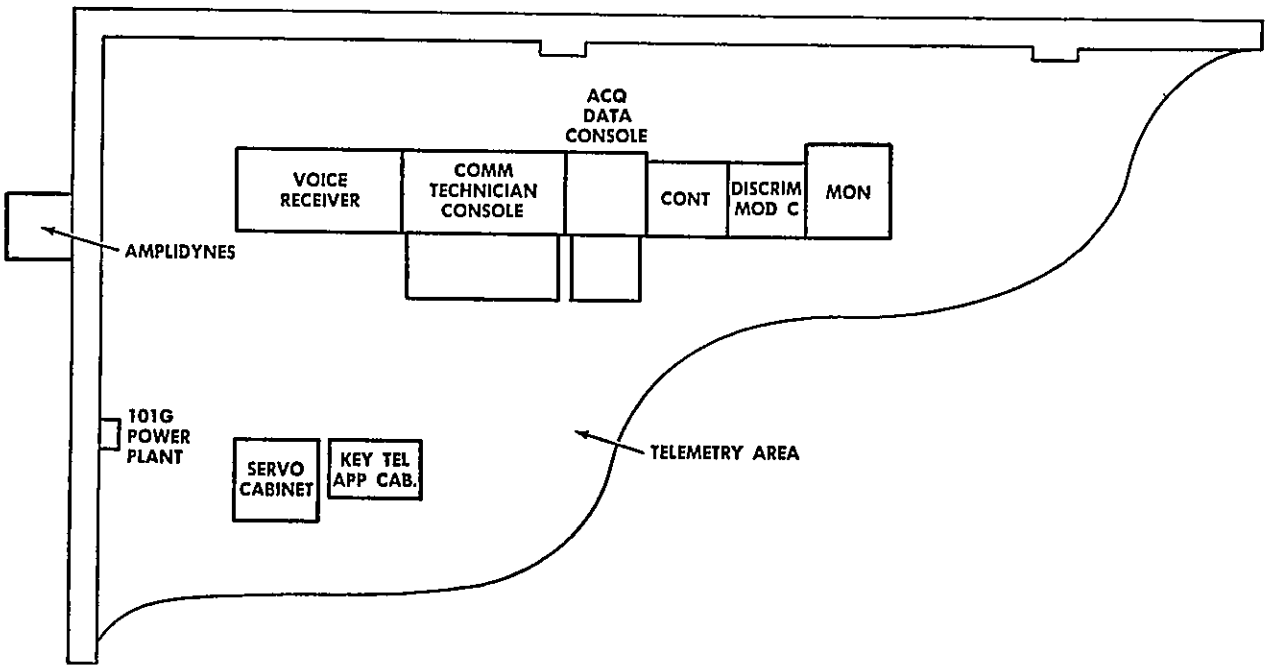


FIGURE 3-16. FLOOR PLAN, TELEMETRY AREA — GRAND TURK ISLAND

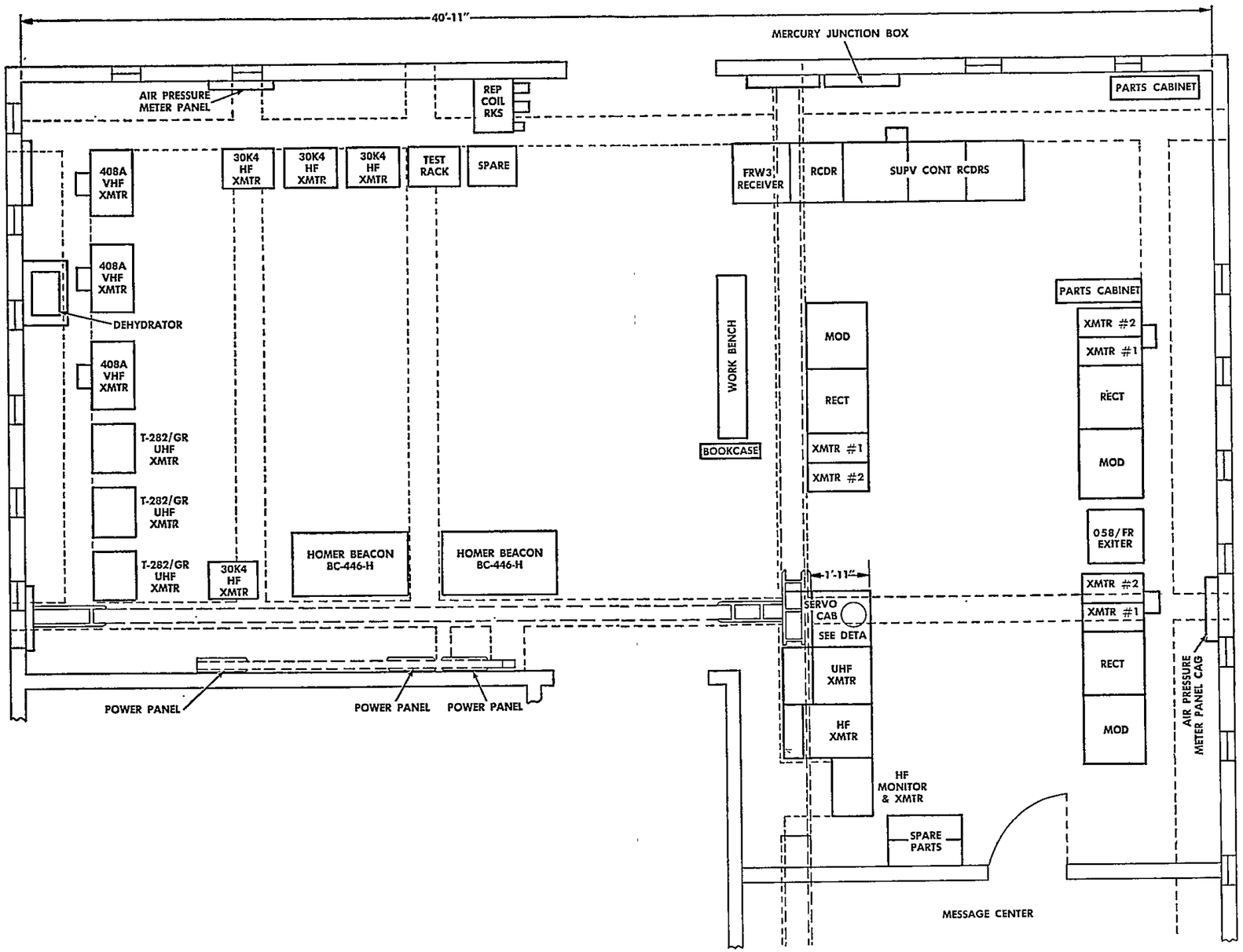


FIGURE 3-17. FLOOR PLAN, TRANSMITTER AREA — GRAND TURK ISLAND

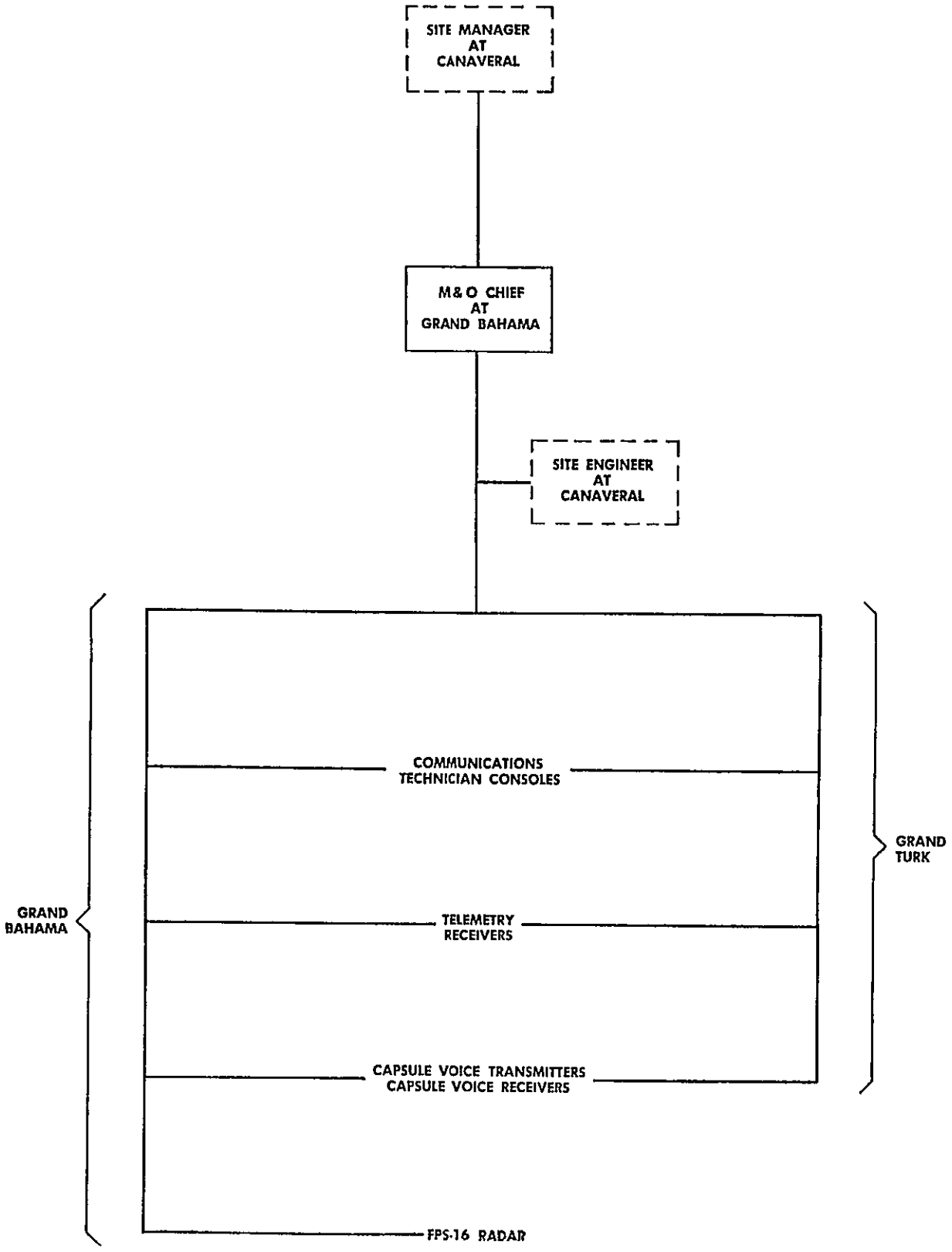


FIGURE 3-18. SITE ADMINISTRATION — GRAND BAHAMA ISLAND AND GRAND TURK ISLAND

Section 4

BERMUDA

TABLE OF CONTENTS

Paragraph	*Title*	*Page*
4.1	Purpose of the Site	4-1
4.2	Systems	4-1
	Ground Communications System	4-1
	Timing System	4-1
	Acquisition System	4-1
	Telemetry System	4-1
	Capsule Communications System	4-3
	Radar Systems	4-3
	Capsule Command Transmitting System	4-4
	Displays	4-4
	Computer	4-4
4.3	Equipment Allocations	4-4
4.4	Equipment Location	4-4
4.5	Site Administration	4-4
4.6	Geographic and Climatic Data	4-6
4.7	Transportation and Communications	4-7
4.8	Site Personnel Facilities and Services (Housing, Medical Facilities, Recreation Facilities, Mail Service, Churches, and Clothing)	4-7
4.9	Miscellaneous Information (Money, Passports, Immunization, and Taxes)	4-7

LIST OF ILLUSTRATIONS

Figure	*Title*	*Page*
4-1	Master Functional Block Diagram—Bermuda	4-9
4-2	Site Equipment Block Diagram, Intrasite Intercommunication System—Bermuda	4-10
4-3	Functional Block Diagram, Timing System—Bermuda	4-11
4-4	Functional Block Diagram, Acquisition System—Bermuda	4-12
4-5	Functional Block Diagram, Telemetry System—Bermuda	4-13/14
4-6	Functional Block Diagram, Transmitting and Receiving Antennas—Bermuda	4-15
4-7	Functional Block Diagram, Air-Ground Communications—Bermuda	4-16/17
4-8	Functional Block Diagram, Radar Data and Teletype—Bermuda	4-18
4-9	Floor Plan, Verlort Radar Van —Bermuda	4-19
4-10	Functional Block Diagram, Ground Radio and Teletype—Bermuda	4-21
4-11	Equipment Block Diagram, Command Transmitter — Bermuda	4-23
4-12	Functional Block Diagram, Display Equipment—Bermuda	4-25
4-13	Functional Block Diagram, Computer—Bermuda	4-26
4-14	Area Map—Bermuda	4-27
4-15	Floor Plan, Control Building—Coopers Island	4-28
4-16	Floor Plan, FPS-16 Building—Coopers Island	4-29
4-17	Floor Plan, Receiver Building—Town Hill	4-31
4-18	Site Administration	4-32

LIST OF TABLES

Table	*Title*	*Page*
4-1	Equipment Allocations — Bermuda	4-5

SECTION 4. BERMUDA

4.1 PURPOSE OF THE SITE

In addition to the functions and systems noted in Figure 1-1, this site is important to Project Mercury for the following reasons.

a. It determines if a satisfactory orbit is achieved by the capsule.

b. It can abort the mission if abnormal flight conditions warrant if Cape Canaveral does not.

c. Computer facilities at Bermuda can be used to predict the capsule point of impact upon immediate or scheduled reentry into the atmosphere.

With the exception of Cape Canaveral, Bermuda is the most complex of the Mercury sites. It is the secondary Mercury control center and has the responsibility for continuing or aborting the mission as the capsule leaves the range of the Cape Canaveral complex.

4.2 SYSTEMS

See Figure 4-1 for a master functional block diagram of the site.

4.2.1 Ground Communications System

These circuits are terminated at the Bermuda site over local telephone company facilities from the Bermuda end of the leased Bermuda-New York circuits to the Harrington telephone central office. New cable facilities from the Harrington central office connect to an existing airfield cable. Voice circuits pass frequencies between 280 and 2800 cycles per second. Teletype circuits are capable of transmitting 60 words per minute in both directions simultaneously. These communications are used for administrative, command and instruction, acquisition, telemetry summary, and digital tracking messages. Figure 1-3 shows the intersite communications network. Figure 4-2 shows the intrasite communications network.

Intrasite communications are made possible by two systems, an intercommunication system connecting Mercury operations positions, and a general purpose system consisting of a 740E dial private branch exchange (PBX) with an associated 552A manual switchboard. An existing cable, supplemented by additional cable where necessary, interconnects Town Hill and Coopers Island control, telemetry, and acquisition aid circuits. Existing cables now connect the Kindley airfield, Harrington central office, and Prospect localities. Circuits are provided from the PBX at Coopers Island to Kindley airfield and to the Harrington central office.

4.2.2 Timing System

A special Mercury timer is provided to time-tag radar and telemetry data.

Time signals from the Bureau of Standards radio station WWV are received at the site on receivers provided for this specific purpose (Figure 4-3). These signals are used as a reference standard against which a stable one-megacycle oscillator is compared and adjusted, so that the locally generated signal agrees in frequency with the received signal. A check of the system is provided by a visual comparison on an oscilloscope of the one-pulse-per-second output from the timing system and the once-per-second tone burst from WWV. The outputs from the timing unit include the following timing signals.

a. An output representing the Greenwich Mean Time (GMT) in hours, minutes, and seconds. This is used in the data processing and data conversion equipment to time-tag the radar data and to drive certain control center displays.

b. A pulse from the timing equipment every six seconds, which causes radar data to be read out.

c. A pulse train with serial time of day (based on GMT) for use with the telemetry data. This unit also operates the clocks showing Greenwich time and elapsed time when required.

4.2.3 Acquisition System

The acquisition aid system at Bermuda, which is equipped with two active acquisition aids, automatically orients the radar, radio, com-

mand, and telemetry antennas (Figure 4-4). Optional manual control of the system allows the antennas to be pointed simultaneously by the Acquisition Aid/Data Console Operator. Independent manual antenna-control by the operator of an equipment which can be slaved to the acquisition system is also possible.

Positional information received by teletype is used by the system operator to initially aim the acquisition system antennas.

Telemetry signals, which are transmitted on two frequencies by the capsule, are used by the acquisition aid for tracking. The Acquisition Aid Console Operator, using the console signal strength meters, selects the stronger of the two signals from the AR-pedestal at Town Hill or the A-pedestal at Coopers Island for automatic control.

Automatic tracking is made possible by the directional-sensing ability of a quad-helix antenna array (on the AR-pedestal at Town Hill or on the A-pedestal at Coopers Island), associated hybrid, and acquisition aid receiver. A telemetry signal, after proceeding through this equipment, is converted into positioning voltages for controlling all antennas under control of the acquisition system. As the radars at the site track the capsule in the narrower beamwidths of their antenna systems, control of antenna pointing is given through the acquisition data console to the radar equipment having the best signal. The acquisition system (AR- and A-pedestals) continues to track the capsule independently of radar system control. This is for site radar reacquisition, should the radars lose the target.

Two types of consoles are used in this system. One of each type is located at Town Hill and also at Coopers Island.

a. The *active acquisition aid console* controls the operation of the active acquisition aid (essentially an automatic direction finder). It does this by manual (handwheel operation with visual position indicators), automatic, or slaved operation of the acquisition aid antenna. Signal strength indications aid in the evaluation and selection of the best telemetry signals for tracking. However, signal strength indications appear only on the Town Hill active acquisition aid console. Azimuth and elevation error-voltage displays also appear on this console.

b. The *acquisition data console* monitors the control mode and the position of the various steerable antennas other than those of the active acquisition aid. Control of these associated antennas is also possible on a manual, automatic, or slaved basis.

In the Bermuda installation, there is mutual control between the consoles at Town Hill and at Coopers Island. Control data is exchanged between consoles. Because of cable distances between the sites, applique circuits are necessary to transmit this information without affecting system operation. These circuits appear in various parts of the circuit configuration and are called synchro remoting equipment and synchro line amplifiers.

Signals associated with systems or equipments appear on the acquisition consoles as follows.

a. Town Hill consoles.

(1) Active acquisition aid control console.

(a) Signals from the telemetry system: Frequencies TM1 and TM2 for signal strength metering and signal selection.

(b) Signals from the active acquisition aid receiver:

1. Error-voltage indications to the console;

2. Sum (signal strength) voltages to the console;

3. Cablewrap.

(2) Acquisition data console.

(a) Active acquisition aid console status: Azimuth, elevation, and control mode indications, including cablewrap.

(b) Town Hill R-pedestal status: Azimuth, elevation, and control mode indications, including cablewrap.

(c) Coopers Island acquisition bus status: Azimuth and elevation indications.

b. Coopers Island consoles.

(1) Active acquisition aid control console: Active acquisition aid (azimuth, elevation, signal strength metering) and cablewrap.

(2) Acquisition data console.

(a) Active acquisition aid status: Azimuth, elevation, and control mode indications, including cablewrap.

(b) Verlort radar status: Azimuth, elevation, and control mode indications.

(c) FPS-16 radar status: Azimuth, elevation, and control mode indications.

(d) Town Hill acquisition bus status: Azimuth, elevation, and control mode indications.

(e) Transmit and command antenna No. 1 status: Azimuth, elevation, control mode indications; cablewrap indication.

(f) Transmit and command antenna No. 2 status: Azimuth, elevation, control mode indications; cablewrap indication.

4.2.4 Telemetry System

Output of the system appears as displays, which are monitored by specialists (Figure 4-5). These specialists (Flight Controllers) advise the Flight Director and/or the Mercury Control Center of abnormal conditions. After each pass of the capsule a teletype summary of the telemetered information is sent to the IBM Space Computing Center and Mercury Control Center at Cape Canaveral. Capsule clock settings and notation of posigrade rockets and retrorocket firings also are sent to the computer at Bermuda to assist in computing the impact point if the flight is terminated in this area.

4.2.5 Capsule Communications System

High-frequency (HF) and ultra-high-frequency (UHF) amplitude modulation (AM) receivers and transmitters are used for voice communications with the capsule. Transmitting antennas and equipment, receiver line amplifiers, remote controls, tape recorder, and flight controller consoles are at Coopers Island. The UHF receiving antennas (which are also used to receive telemetry and acquisition aid information), triplexers, preamplifiers, receivers, and diversity combiners are at Town Hill. Separate dipole antennas are affixed to the UHF quadhelix antennas for the HF receivers (and transmitters). See Figure 4-6 for a functional block diagram of air-ground antennas. See Figure 4-7 for a functional block diagram of air-ground transmitters and receivers.

Effective receiver system reliability is ensured by two frequency bands, antenna space diversity, two receivers per frequency, diversity combiners, and versatile switching arrangements at the communications technician console to make use of the most satisfactory signal. Test signal generators for both frequencies are located at Town Hill under remote control from Coopers Island. Transmitting system reliability is ensured by providing standby transmitters for both frequencies. Manual switchover to standby equipment is provided in case of transmitter failure. Switching allows transmitting on either or both frequency systems. Patching also allows ready use of standby transmitting antenna assemblies.

NOTE

Emergency forms of communication with the capsule are available at command sites such as Bermuda. The telemetry transmitter in the capsule can be keyed for interrupted continuous-wave (ICW) transmission to the site, and the command transmitter can be voice modulated for transmission to the capsule.

4.2.6 Radar Systems

Bermuda uses Verlort (S-band) and FPS-16 (C-band) radar systems.

4.2.6.1 Verlort Radar

Verlort radar, located at Coopers Island (Figure 4-9), has a nominal range of 700 miles, and supplies precise tracking data (Figure 4-8).

After the tracking data has been processed by data conversion equipment, it is sent by teletype to the Goddard computing center. In addition to its basic function, Verlort radar supplies data to the acquisition system for site antenna positioning when in a valid tracking mode. The antenna can also be trained on the target (capsule) by the acquisition system.

4.2.6.2 FPS-16 Radar

The FPS-16, also at Coopers Island (Figures 4-10, 4-16), has a narrower beamwidth in its antenna system, providing more precise tracking information over the nominal 500-mile range of the unit. Data handling requirements for conversion to teletype format apply. This unit is incorporated into the acquisition system both as a directed and as a directing unit, as is the Verlort radar.

Data from both radar systems is also fed to a computer at Bermuda. Rapid computations immediately after launch determine if the capsule orbit is within acceptable limits, or whether the flight should be aborted. After normal launch, the radar systems function as a data source for the Goddard computer, as do the radars at other sites.

Figure 4-8 shows a functional block diagram of the radar system and radar data processing system. Figure 4-10 shows a functional block diagram of the radar data inputs to the teletype equipment and ground radio facilities. The Verlort van floor plan is shown in Figure 4-9.

4.2.7 Capsule Command Transmitting System

Bermuda is one of six sites provided with facilities for commanding emergency return of the capsule (Figure 4-7). A 10-kw amplifier, added to the usual UHF 500-watt command transmitter, ensures reception of commands by the capsule regardless of its attitude or inability of the Astronaut to operate his controls. An additional 500-watt FRW-2 amplifier is supplied for backup.

Reliability of the system is increased by providing spare equipment, and monitoring and switching facilities as follows (Figure 4-11).

a. An automatic monitor and switchover system detects failure of the regular FRW-2 (500-watt) amplifier, which is used in conjunction with the 10-kw final amplifier. An automatic switchover then replaces the master FRW-2 unit with the standby unit.

b. Failure of the 10-kw amplifier is detected by the monitor and switchover system. Coaxial switches are then actuated to bypass the 10-kw amplifier and to use the FRW-2 (500-watt) master unit as a low-power transmitter.

c. Failure of the FRW-2 (500-watt) master unit results in automatic switchover to the remaining FRW-2 (500-watt) standby unit as the command transmitter.

d. Switches are provided to allow transmission on either of two antennas at Coopers Island (Figure 4-7). Excluding antenna switching possibilities, therefore, there are four possible methods of transmitting command information. Reception of the commands is verified by responses received by the telemetry system. The antenna system is steerable and is under primary control of the acquisition data console on Coopers Island.

4.2.8 Displays

Displays in the Coopers Island control building (Figure 4-12) indicate the position of the capsule and a predicted landing point if the retrofire rockets are fired in the Bermuda area. Other console displays assist Flight Controllers in their decision to abort or continue the mission, and also assist in capsule location and recovery at the end of the mission. Other displays are discussed under their associated systems, e.g., the displays associated with the acquisition system.

4.2.9 Computer

See Figure 4-13 for the interconnection between the type 709 computer and the other equipment at this site. A summary of Bermuda computer results is sent to Goddard for comparison.

4.3 EQUIPMENT ALLOCATIONS

Table 4-1 lists major equipments, grouped by system, and the manufacturer or source from whom the equipment is obtained.

4.4 EQUIPMENT LOCATION

The Mercury equipments are located at Town Hill and Coopers Island, as shown in Figures 4-14 through 4-17.

4.5 SITE ADMINISTRATION

Site administration is shown in chart form in Figure 4-18.

TABLE 4-1

EQUIPMENT ALLOCATIONS — BERMUDA

System	*Equipment*	*Type or Model*	*Supplied By*
Acquisition	Active Acquisition Aid		Cubic
	Acquisition Data Console (includes the Acquisition Aid Console)		Bendix Radio
Radar	S-band	Verlort	Reeves
	C-band	FPS-16	RCA
Telemetry	Preamplifier	PR-203	Nems-Clarke
	Receiver	1434	Nems-Clarke
	Receiver	1412	Nems-Clarke
	Diversity Combiner	DCA-500	Nems-Clarke
	Decommutators, 90-Channel	TDS-90	Arnoux
	Discriminators	TDA-102	Bendix
	Tape Recorder	FR-114	Ampex
Ground Communications	Dial Private Branch Exchange	740E	Western Electric
	Manual Switchboard	552A	Western Electric
	Teletype:		
	Receive only	28RO	Teletype Corp.
	Auto. send and receive	28ASR	Teletype Corp.
	Receive only—Typing Reperforator	28ROTR	Teletype Corp.
Air-Ground Communications	Preamplifier	PR-203	Nems-Clarke
	HF Transmitter	CS-2029	Gates
	HF Receiver	R-390A/URR	Collins
	UHF Transmitter, consisting of:	AN/GRT-3	Radio Receptor
	UHF Transmitter	T282/GR	Radio Receptor
	Modulator Power Supply	MD-141A/GR	Radio Receptor
	Microphone Amplifier	M5167	Gates
	UHF Receiver	278B/GR	Collins
	Power Modulation Monitor	SG 41.1 and SG 41.2	Jones
	Tape Recorder	728	Magnacord
	Sidetone Line Amplifier	BXR-LA 200	Bendix Radio
	Communications Technician Console	BXR-CTC 500	Bendix Radio
	Dual Diversity Combiner	BXR-BDU 100	Bendix Radio

(Continued)

TABLE 4-1. EQUIPMENT ALLOCATIONS—BERMUDA *(Continued)*

System	*Equipment*	*Type or Model*	*Supplied By*
Radar Tracking—Data Processing	Polar/Cartesian Coordinate Converter	4003	Milgo
	Plotboard	3010	Milgo
Timing System	Time Standard Rack Assembly		Bendix Radio
Computing	Computer	709	IBM
Displays	Time Display		Bendix Radio
	Countdown Indicator		Bendix Radio
	Flight Dynamics Officer		Stromberg-Carlson
	Capsule Environment Monitor		Stromberg-Carlson
	Capsule System Monitor		Stromberg-Carlson
	Flight Surgeon		Stromberg-Carlson
	Capsule Communicator		Stromberg-Carlson
	Flight Supervisor		Stromberg-Carlson
Capsule Command Transmitting	Power Amplifier (10-kw)	240 D2	Alpha
	Transmitter (500 watts)	AN/FRW-2	Alpha
	Monitor Receiver	R669/URW	Alpha
	Audio Decoder	KY172/URW	Alpha
	Power and VSWR Monitor	SG 23.16	M. C. Jones
	Power and VSWR Monitor	SG 33.17	M. C. Jones
	Switchover Control and Status Panel		Alpha
	Audio Coder	KY171	Alpha
	100 Channel Events Recorder	429988-910	Brush
	Coder Control Equipment		Bendix, Cincinnati

4.6 GEOGRAPHIC AND CLIMATIC DATA

Bermuda is a group of closely spaced, emergent limestone islands located about 750 miles southeast of New York City at 32°36′ N, 64°66′ W.

The climate is mild with an average temperature of 78° F in the summer and 64° F in the winter. The average rainfall is 58 inches, occurring mainly between July and October. High and low temperatures and average humidity figures are:

	High	*Low*	*Average Humidity*
Summer	99°F	58°F	77%
Winter	81°F	40°F	75%

Between 1926 and 1955, Bermuda experienced six hurricanes. There is an average of 37 gale-wind days per year. Structures are designed for a wind velocity of 125 mph.

4.7 TRANSPORTATION AND COMMUNICATIONS

Air travel is the most popular method of travel between the U.S. and Bermuda. BOAC, Pan American, Eagle, Eastern, and TCA airlines provide connecting flights between New York and Bermuda. Steamship travel is also available on Royal Mail Line, Cunard, Furness, and Grace Line. Ferry services are available between the islands.

Bus transportation to site facilities is non-existant from offsite locations. Transportation arrangements should be verified through lines of organization prior to departure for Bermuda. Taxis are available at rates comparing favorably with those of the U. S. Size limitations are in effect on motor vehicles (166 inches long, 64 inches wide), and customs duties on incoming vehicles are high. British cars may be purchased locally in a price range of from $1450 to $2350 at the current rate of exchange. Gasoline is approximately 51 cents per gallon. Operators' licenses may be applied for after 30-days residence. Application and examination cost $1.40; the license also costs $1.40, plus medical fees for a physical fitness certificate.

Telephone and cable services are available for local and foreign service.

4.8 SITE PERSONNEL FACILITIES AND SERVICES

Personnel assigned to Bermuda live in offsite housing. Hotel rates range from $10.00 a day usually to $23.80 a day on the modified American plan (room and two meals a day). Hotel showers usually use salt water. (Fresh water showers are available at the Castle Harbour Hotel.)

Furnished apartments range from $170.00 a month, but rental and leasing arrangements must be approved by local rent and price control authorities. Apartments which meet these price vs. accommodation specifications are not easily found.

A modern, well-equipped hospital (King Edward VII Memorial Hospital) is available with various specialists in attendance. Medical and dental fees are considered above U.S. averages.

Boating, fishing, tennis, golf, and riding are available. British and American films are shown at several indoor and outdoor locations. Hotels provide entertainment for their guests. There is a public library for which subscription is levied. A free reference library is located in Hamilton with a branch in Somerset. Radio programs are broadcast daily. There is also a television station that broadcasts each evening.

Airmail service to New York requires one day.

Services for all denominations are available at Kindley airfield. Local churches are mostly Anglican.

Since the temperature extremes are 99° F in summer to 40° F in winter, a variety of clothing is necessary for comfort. Local stores supply both cottons and woolens. Cottons are available in a variety of grades and prices. Variety is somewhat restricted in woolen goods, however, so that it may be desirable to bring this type of clothing.

4.9 MISCELLANEOUS INFORMATION

U.S. dollars or the British pound sterling is used. As of March 1, 1960, the pound (£) was valued at $2.80. A shilling (s) is 1/20 of a pound (14¢); a penny (d) is 1/12 of a shilling. The following information applies generally to Bermuda visits. Current and specific information relating to immigration regulations should

be obtained through lines of organization prior to departure.

Passports are not required for visiting. Visitors may remain in the colony for six months without a permit, but Board of Immigration (Hamilton) permission must be obtained to extend the visit beyond this time. On arrival, visitors must produce positive evidence of their intention to depart, in the form of a ticket to their point of origin or to a destination outside of Bermuda. Permission to land must be obtained from the Board of Immigration if traveling on a one-way ticket.

Everyone going to Bermuda must have been vaccinated against smallpox within three years of the visit and must have a certificate to this effect in his possession.

There are no local income taxes or death duties. A head tax of one pound is levied at the time of departure from the island.

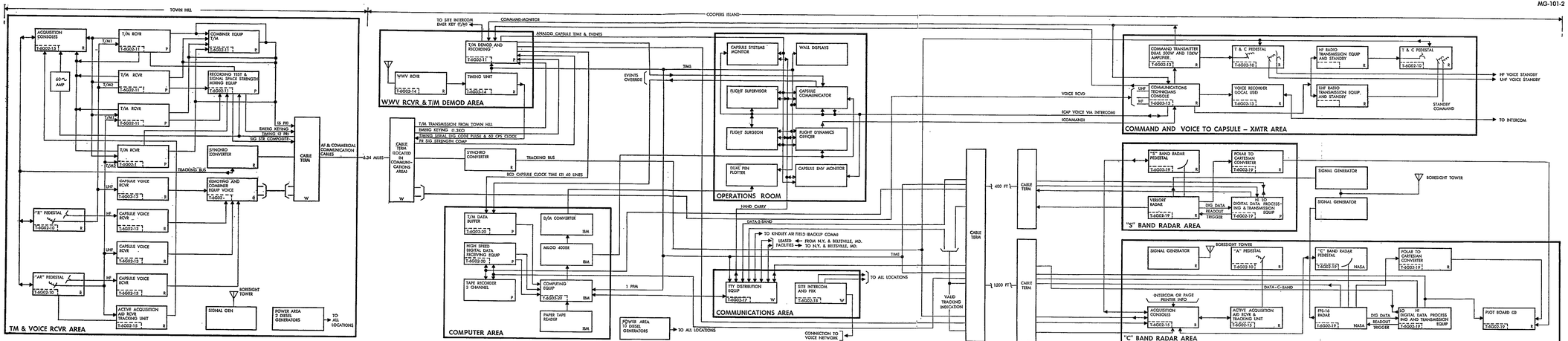


FIGURE 4-1. MASTER FUNCTIONAL BLOCK DIAGRAM— BERMUDA

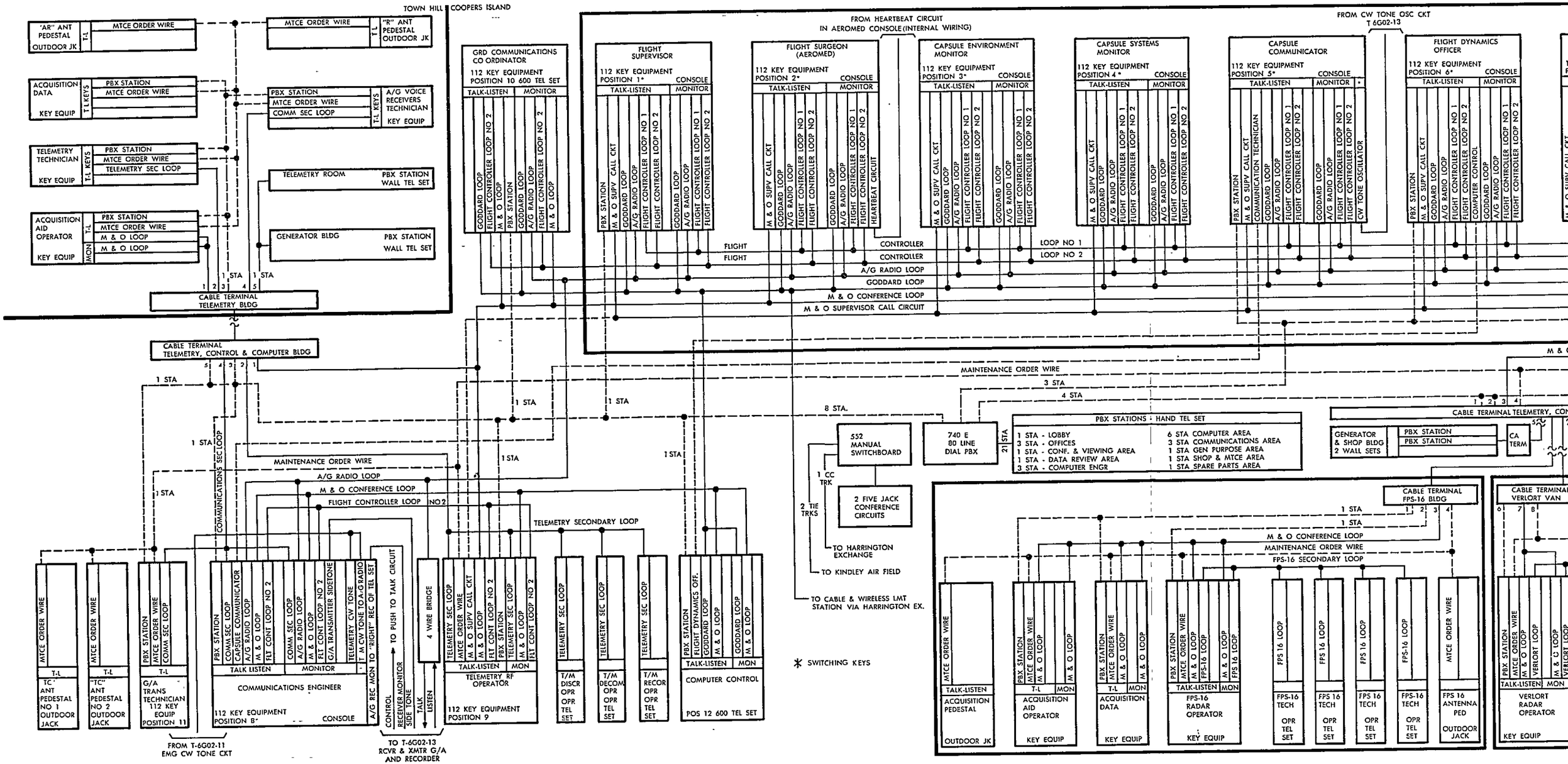


FIGURE 4-2. SITE EQUIPMENT BLOCK DIAGRAM, INTRASITE INTERCOMMUNICATION SYSTEM — BERMUDA

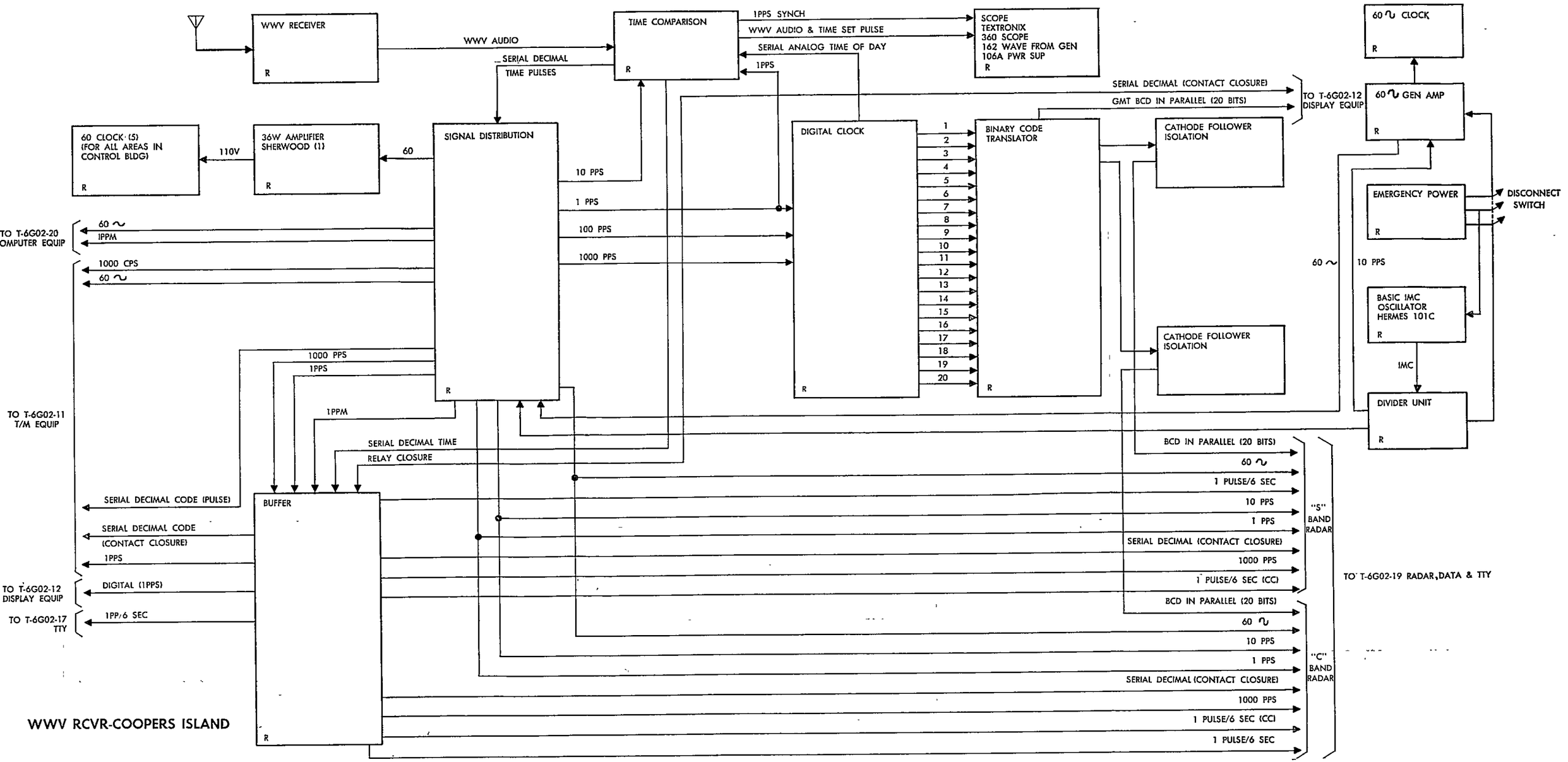


FIGURE 4-3. FUNCTIONAL BLOCK DIAGRAM, TIMING SYSTEM — BERMUDA

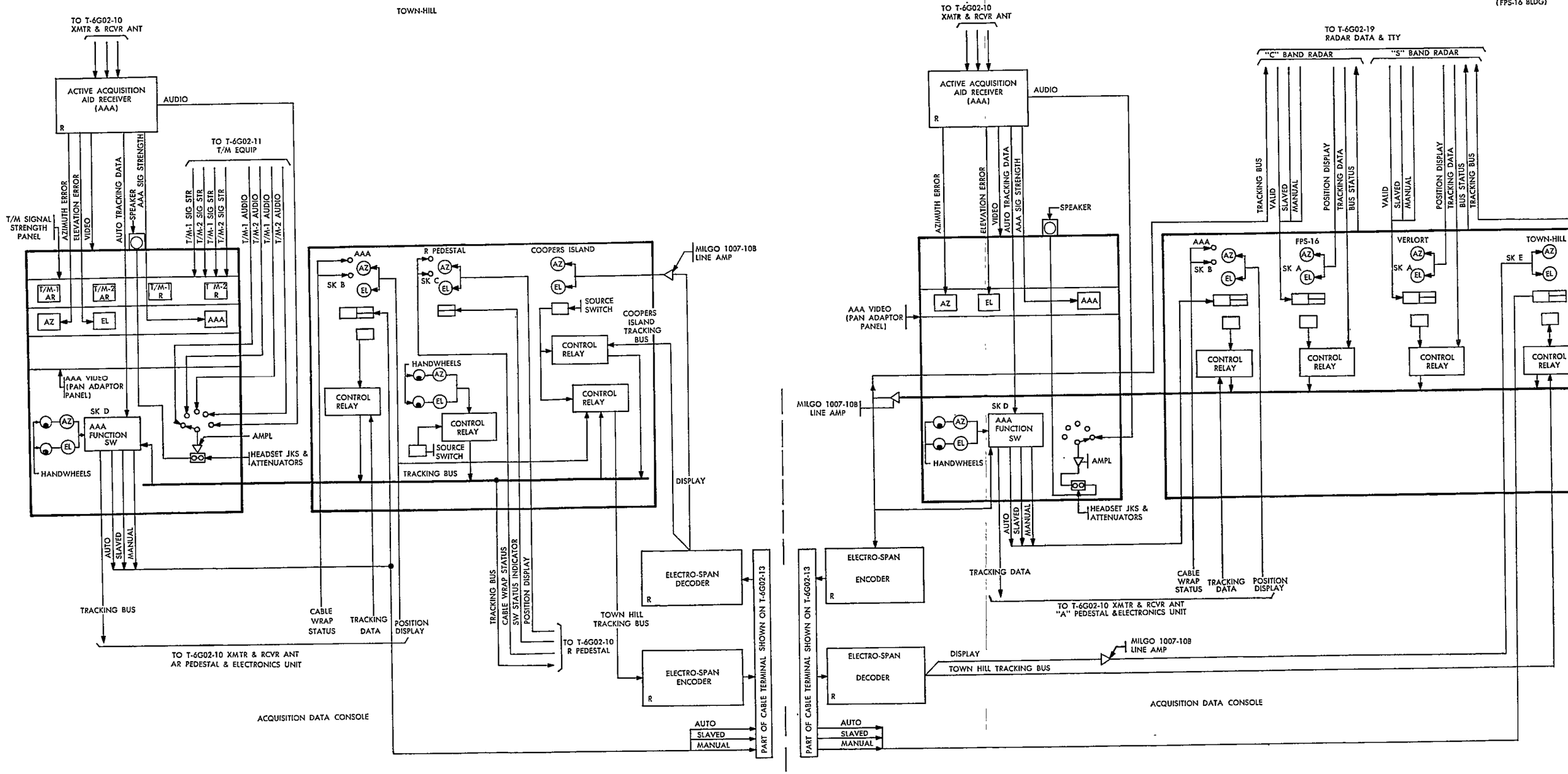


FIGURE 4-4. FUNCTIONAL BLOCK DIAGRAM, ACQUISITION SYSTEM—BERMUDA

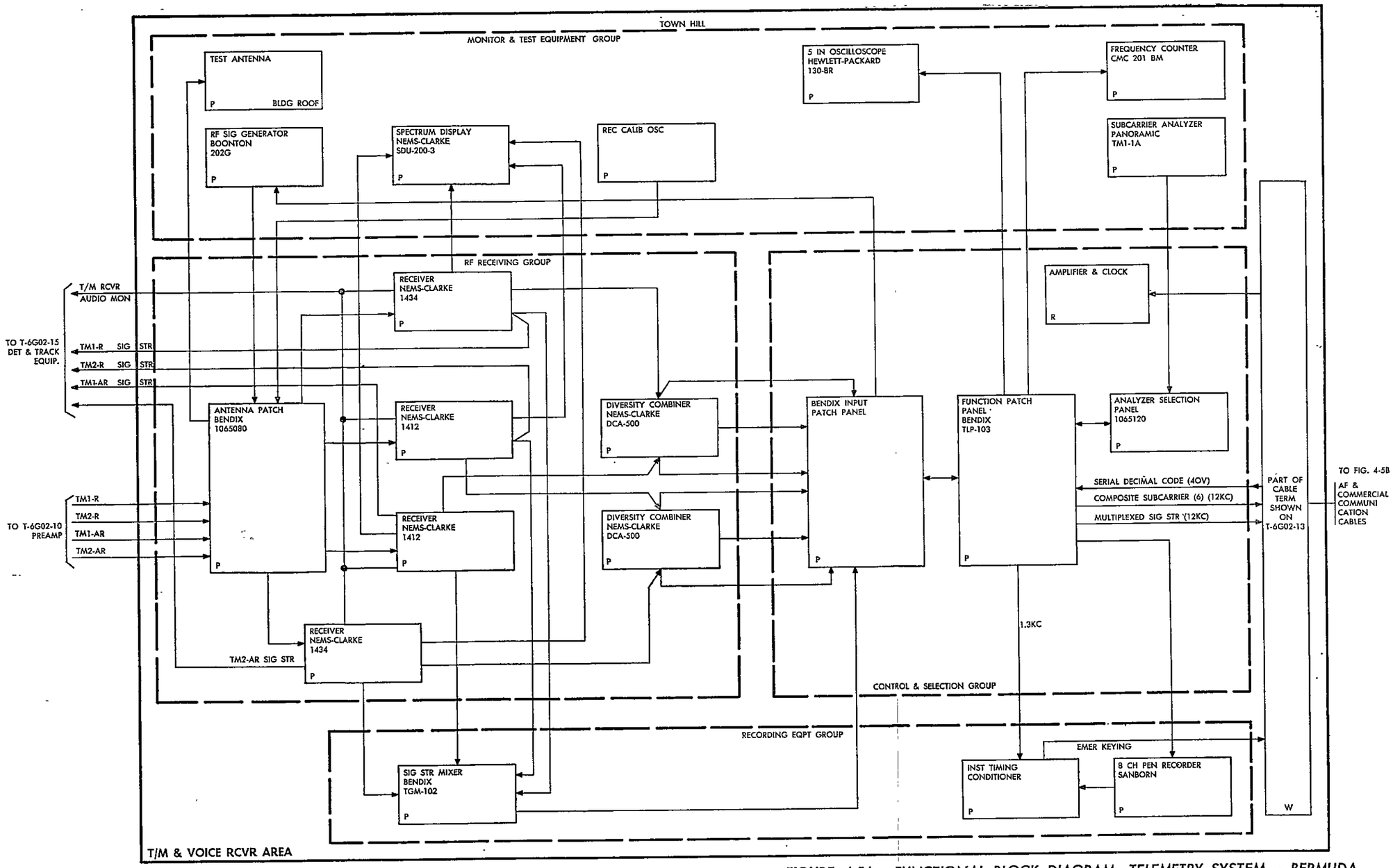


FIGURE 4-5A. FUNCTIONAL BLOCK DIAGRAM, TELEMETRY SYSTEM — BERMUDA

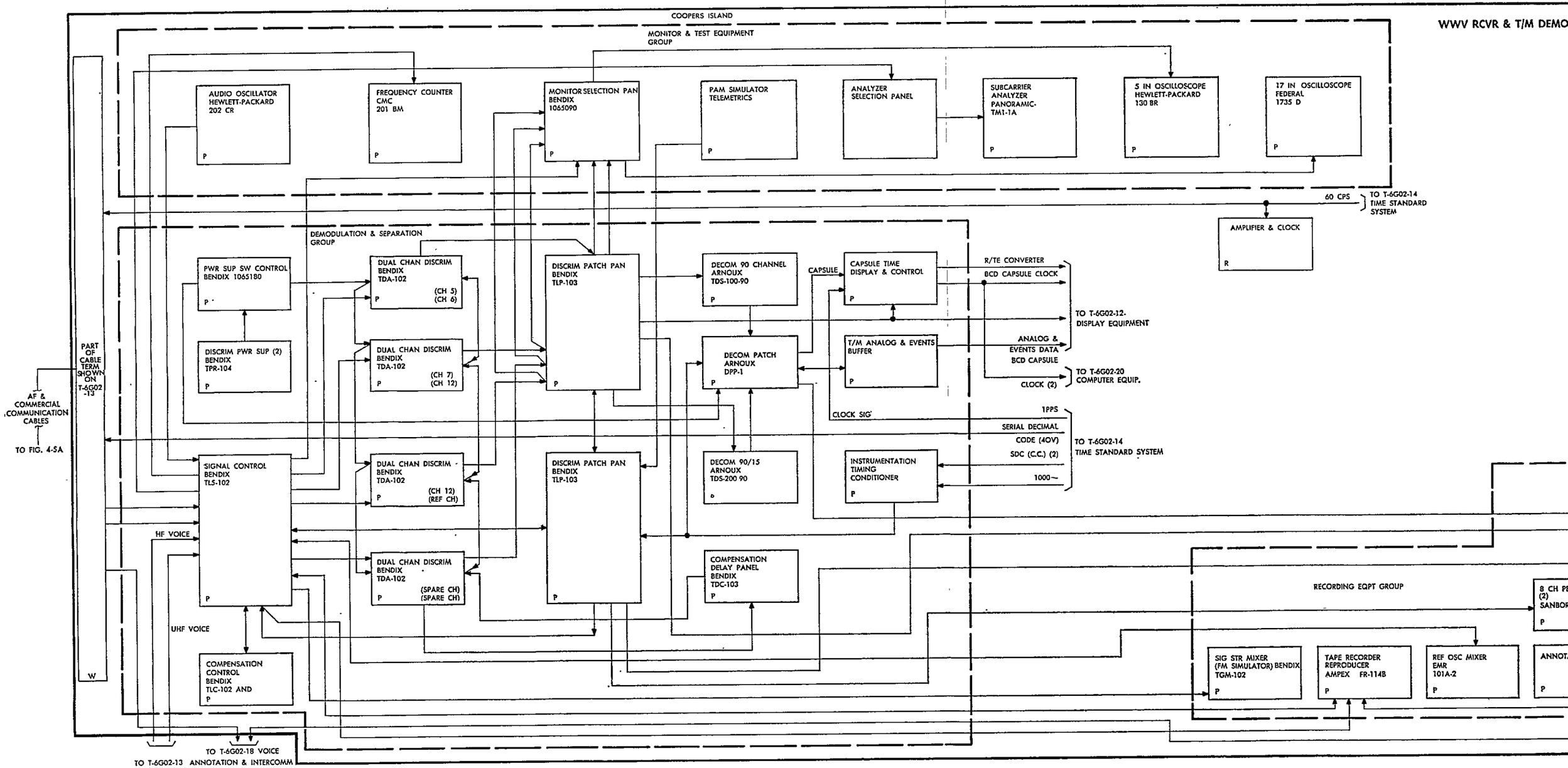


FIGURE 4-5B. FUNCTIONAL BLOCK DIAGRAM, TELEMETRY SYSTEM — BERMUDA

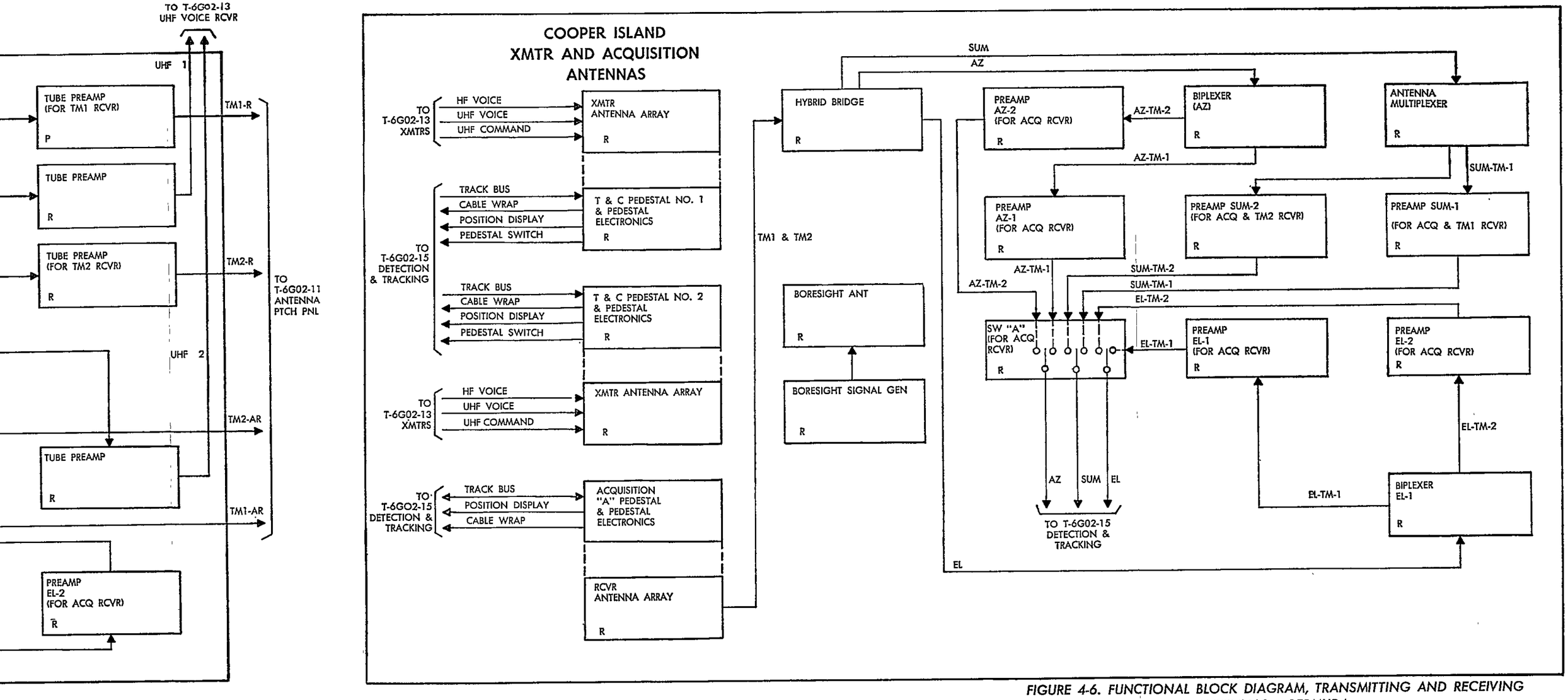


FIGURE 4-6. FUNCTIONAL BLOCK DIAGRAM, TRANSMITTING AND RECEIVING ANTENNAS — BERMUDA

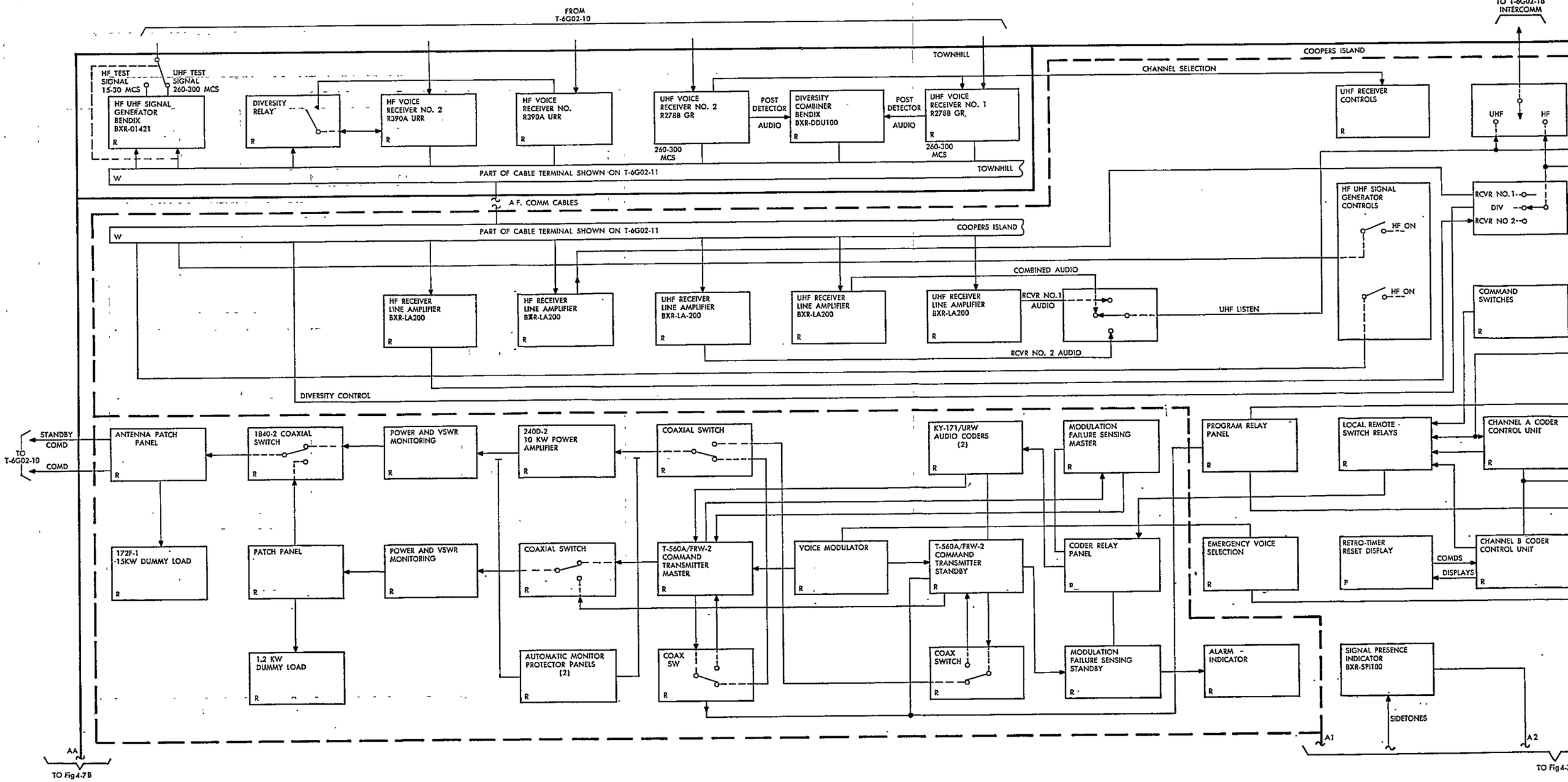


FIGURE 4-7. FUNCTIONAL BLOCK DIAGRAM, AIR-GROUND COMMUNICATIONS — BERMUDA

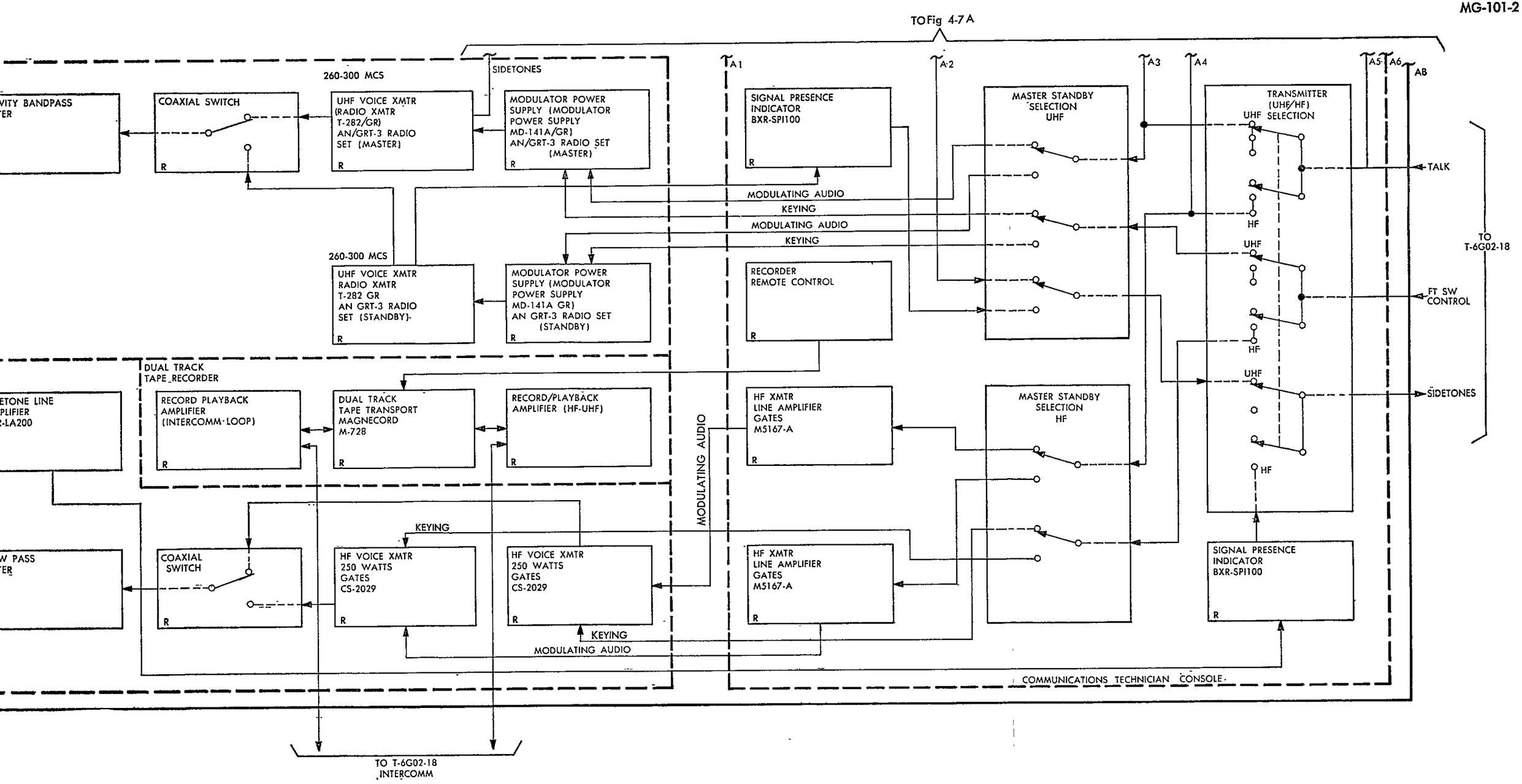


FIGURE 4-7B. FUNCTIONAL BLOCK DIAGRAM, AIR-GROUND COMMUNICATIONS — BERMUDA

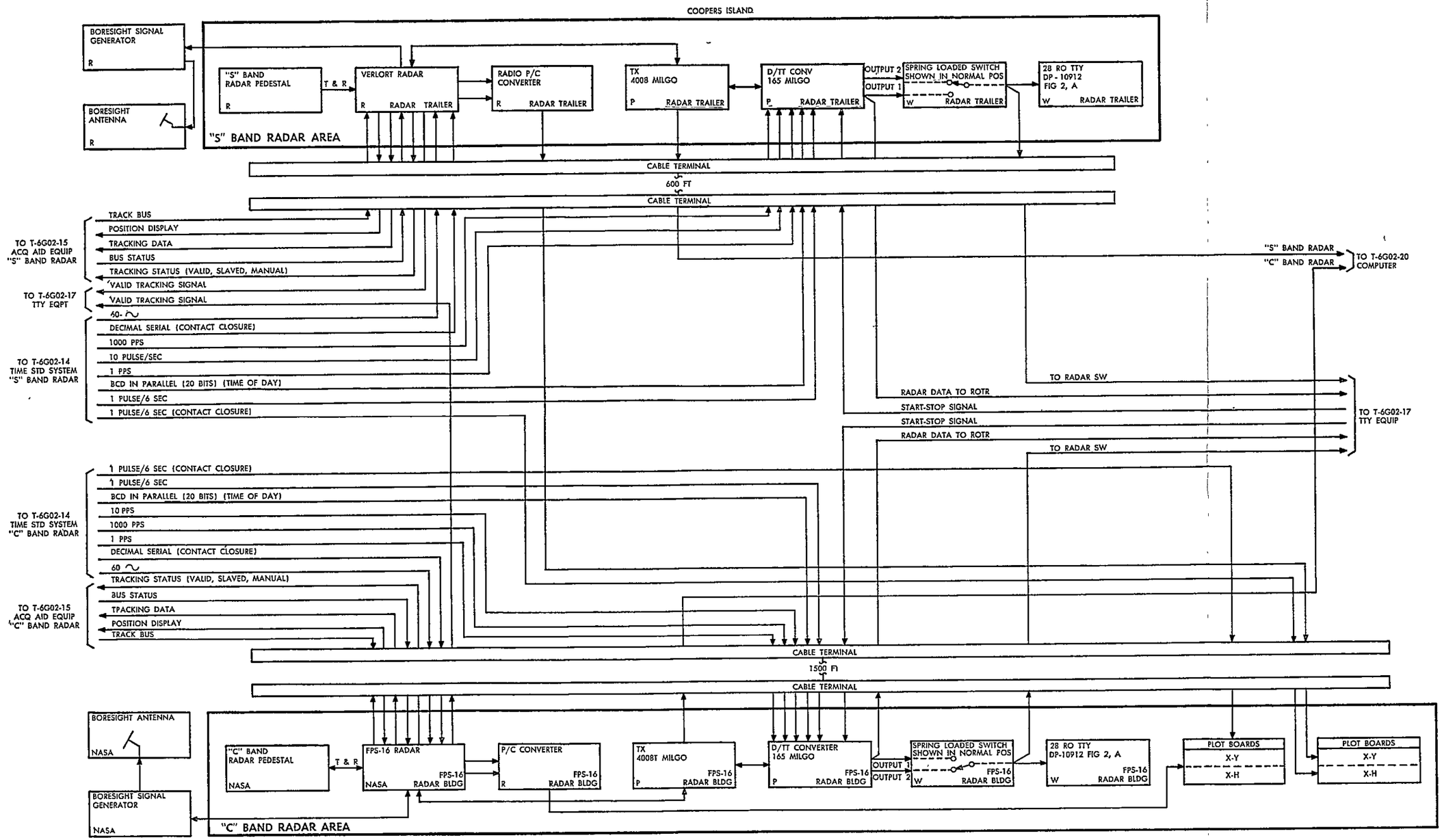


FIGURE 4-8. FUNCTIONAL BLOCK DIAGRAM, RADAR DATA AND TELETYPE — BERMUDA

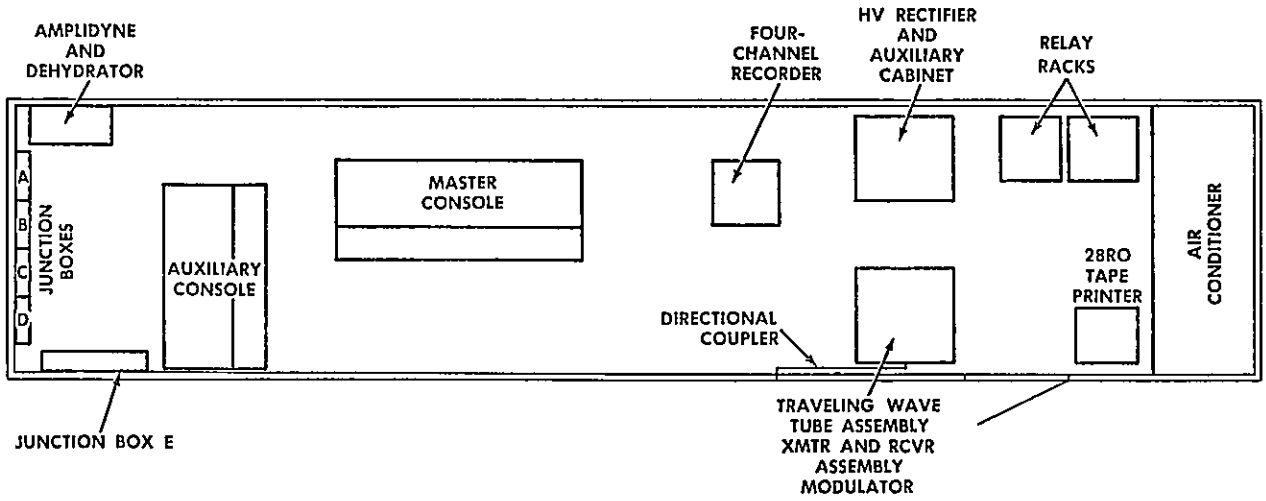


FIGURE 4-9. FLOOR PLAN, VERLORT RADAR VAN — BERMUDA

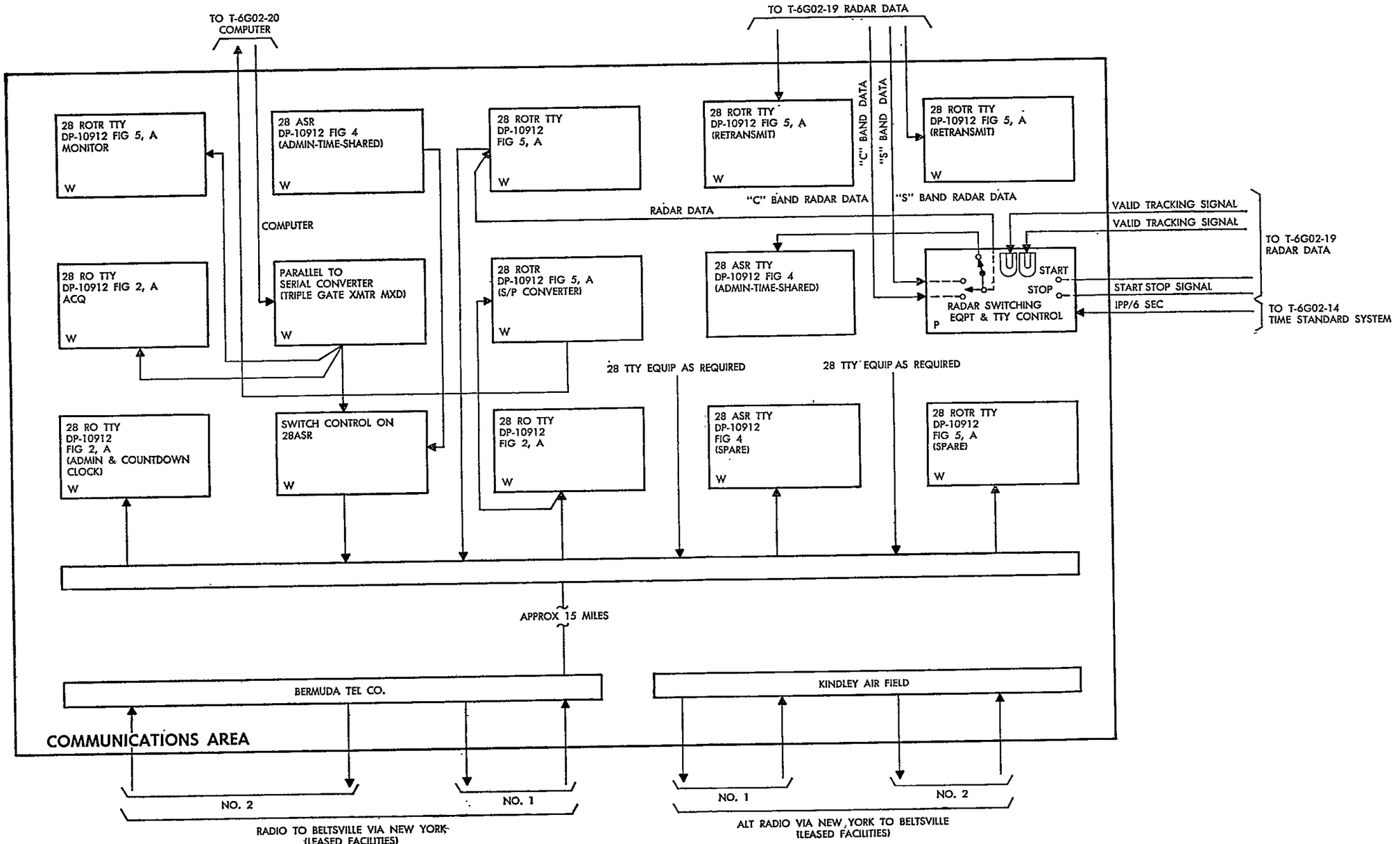


FIGURE 4-10. FUNCTIONAL BLOCK DIAGRAM, GROUND RADIO AND TELETYPEWRITER— BERMUDA

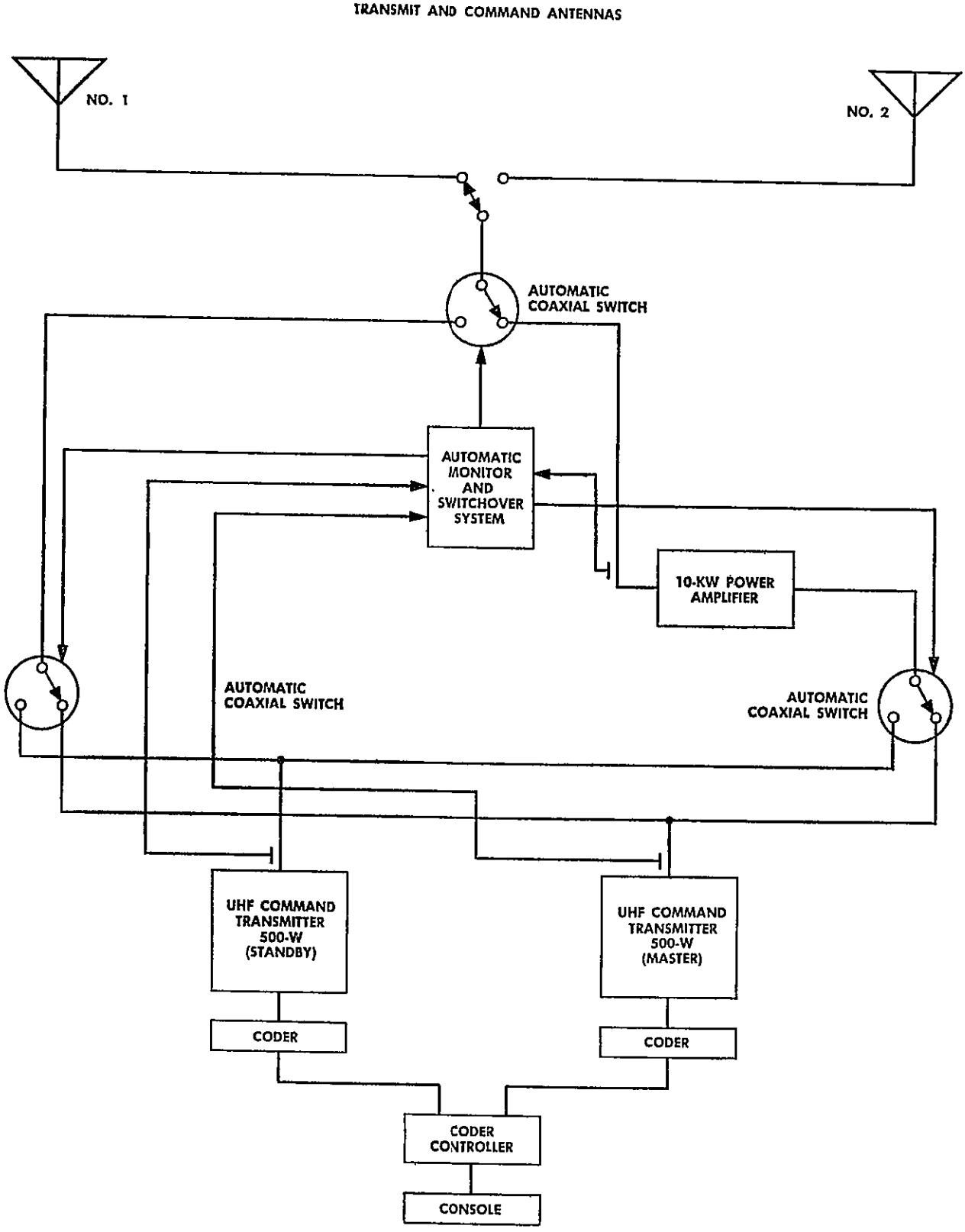


FIGURE 4-11. BLOCK DIAGRAM, COMMAND TRANSMITTER EQUIPMENT — BERMUDA

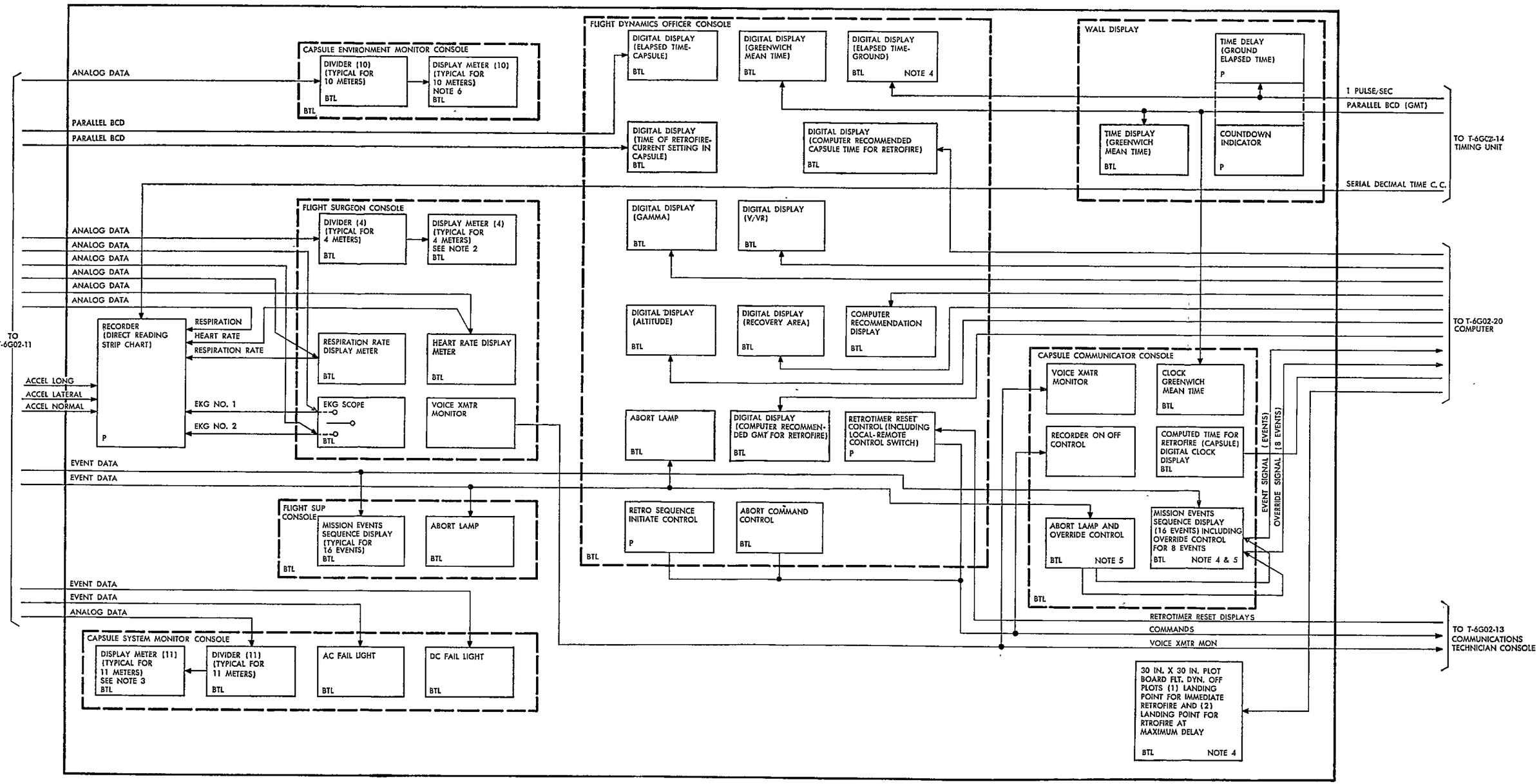


FIGURE 4-12. FUNCTIONAL BLOCK DIAGRAM, DISPLAY EQUIPMENT — BERMUDA

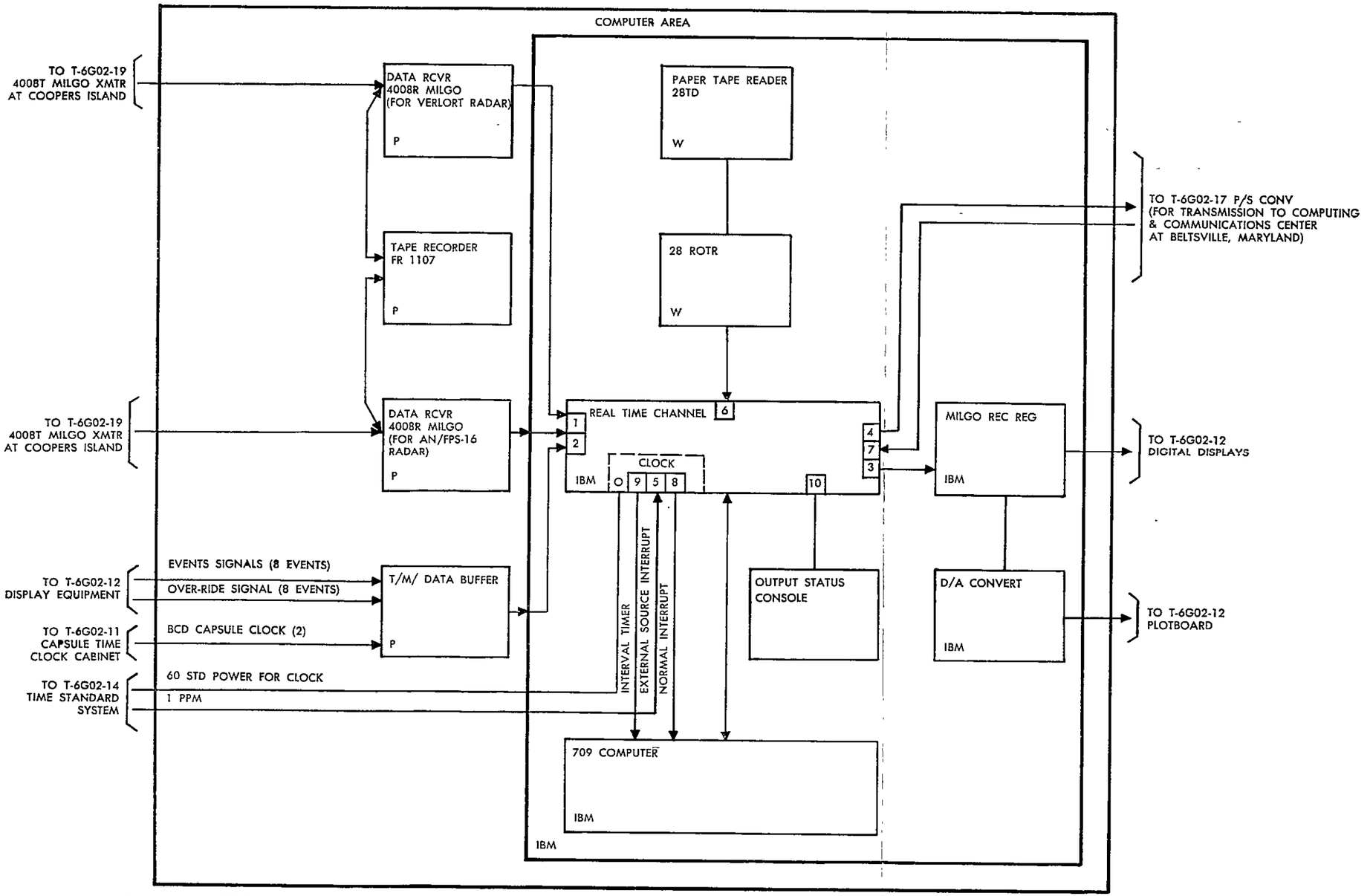


FIGURE 4-13. FUNCTIONAL BLOCK DIAGRAM, COMPUTER — BERMUDA

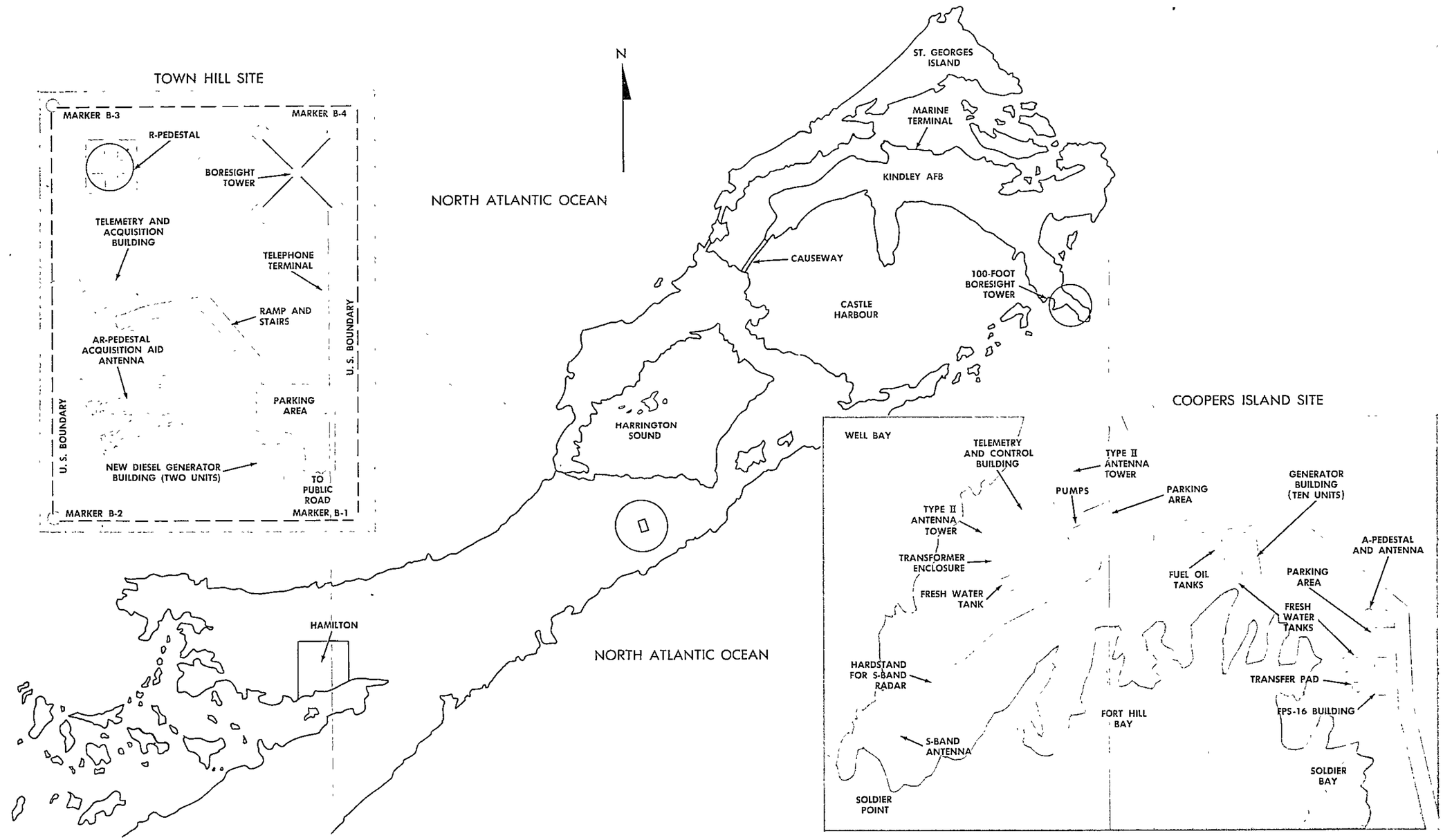


FIGURE 4-14. AREA MAP — BERMUDA

LEGEND

AREA I

TRANSMITTER EQUIPMENT AND COMMUNICATIONS AREA
1. COMMUNICATIONS TECHNICIAN CONSOLE
2. AN/FRW-2 TRANSMITTER
3. UHF TRANSMITTER
4. TERMINAL EQUIPMENT
5. HF TRANSMITTER
6. HEAT EXCHANGER
7. KLYSTRON
8. CONTROL
9. FILTER
10. BEAM SUPPLY
11. SERVO

AREA II

COMPUTER AREA
12. TELEMETRY ANALOG/DIGITAL CONVERTER
13. DATA RECEIVER-TRANSMITTER
14. TAPE RECORDER
15. DIGITAL/ANALOG CONVERTER
16. RECEIVER REGISTER

AREA III

TELEMETRY AREA
17. CAPSULE TIME DISPLAY AND CONTROL
18. DECOMMUTATOR MONITOR
19. 90/90 DECOMMUTATOR
20. 90/15 DECOMMUTATOR
21. RECORDER
22. PEN RECORDER
23. TIMING STANDARD
24. DISCRIMINATOR COMMAND
25. CALIBRATION MODULATOR "A"
26. CONTROL
27. REPRO PRECISE
28. TAPE RECORDER

AREA IV

CONTROL AREA (OPERATIONS)
29. COMMON EQUIPMENT
30. FLIGHT SURGEON
31. CAPSULE ENVIRONMENTAL MONITOR
32. CAPSULE COMMUNICATOR
33. CAPSULE SYSTEMS MONITOR
34. FLIGHT DYNAMICS
35. FLIGHT SUPERVISOR
36. M & O SUPERVISOR DESK
37. PLOT BOARD

C SIDE CHAIR WITHOUT ARMS
C SWIVEL ARMCHAIR
C POSTURE CHAIR
S STOOL

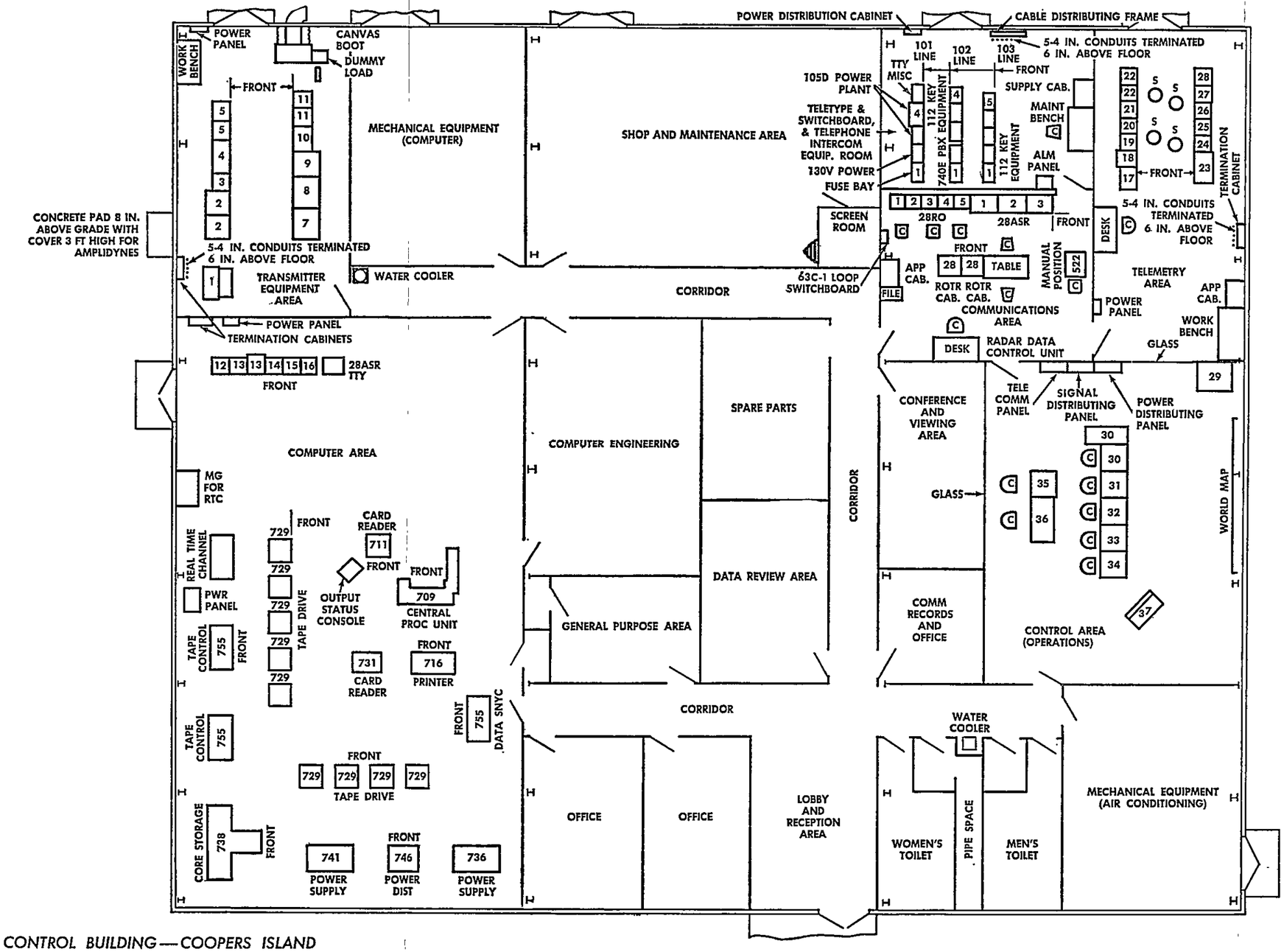


FIGURE 4-15. FLOOR PLAN, TELEMETRY AND CONTROL BUILDING—COOPERS ISLAND

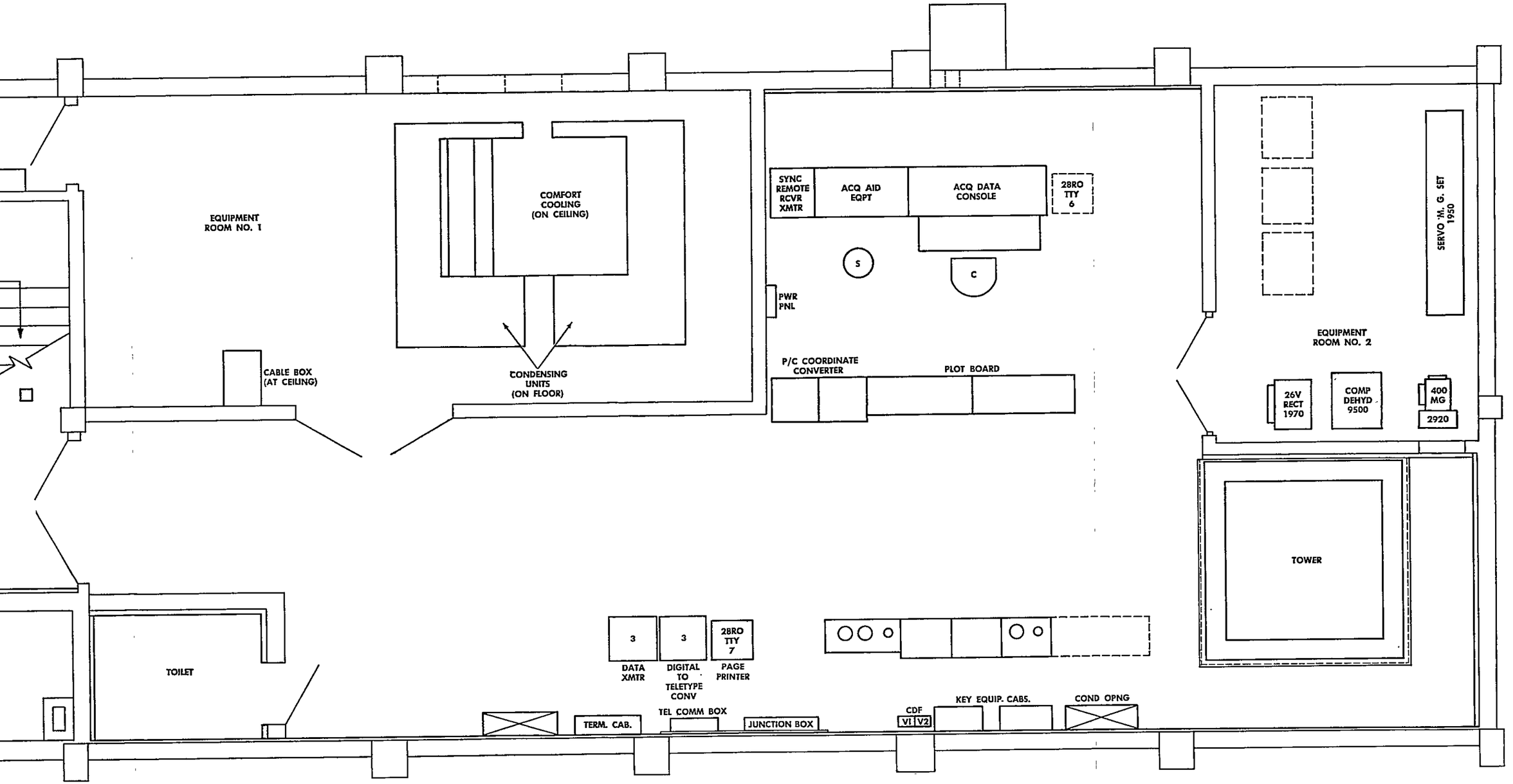


FIGURE 4-16. FLOOR PLAN, FPS-16 BUILDING — COOPERS ISLAND

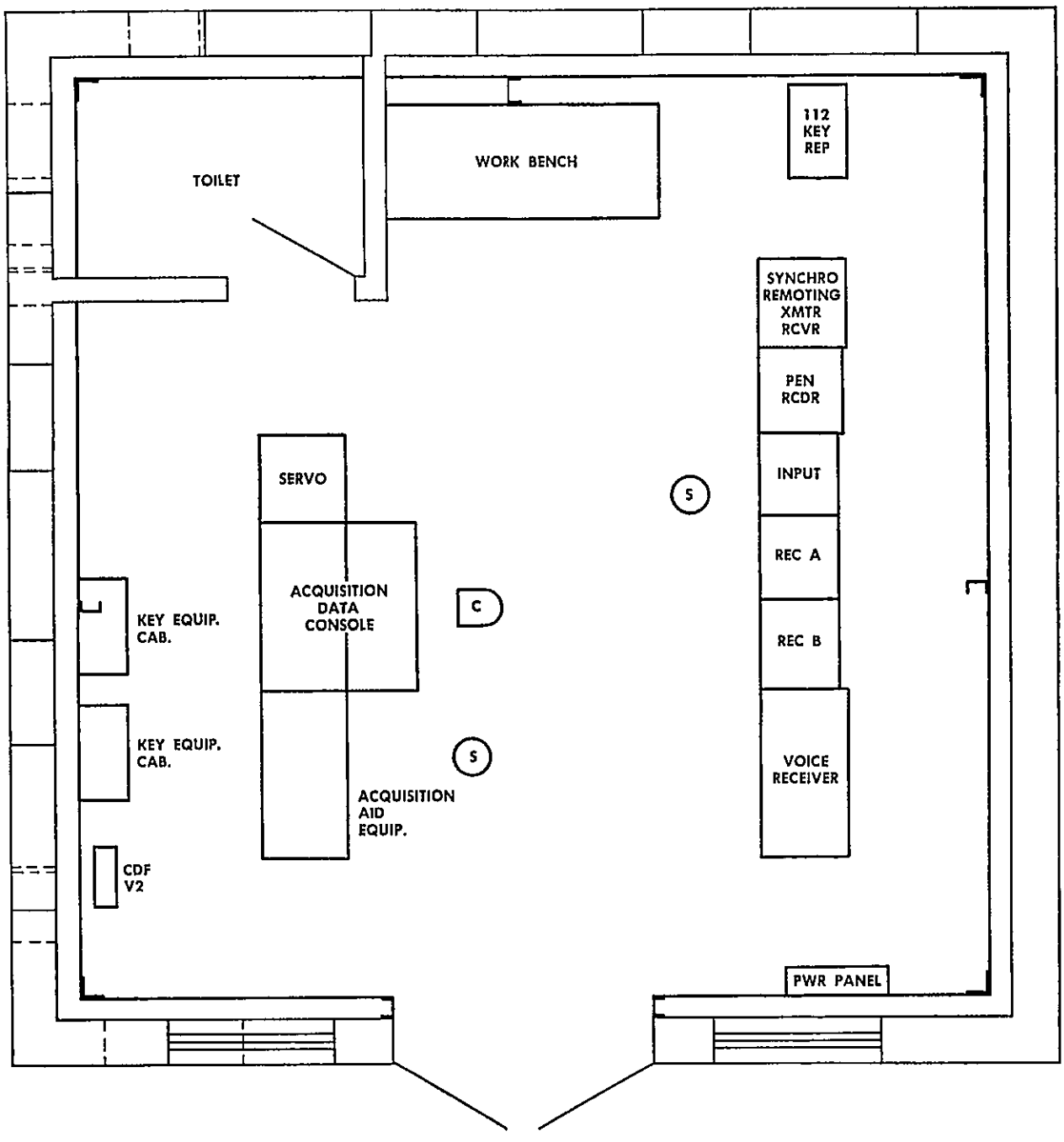
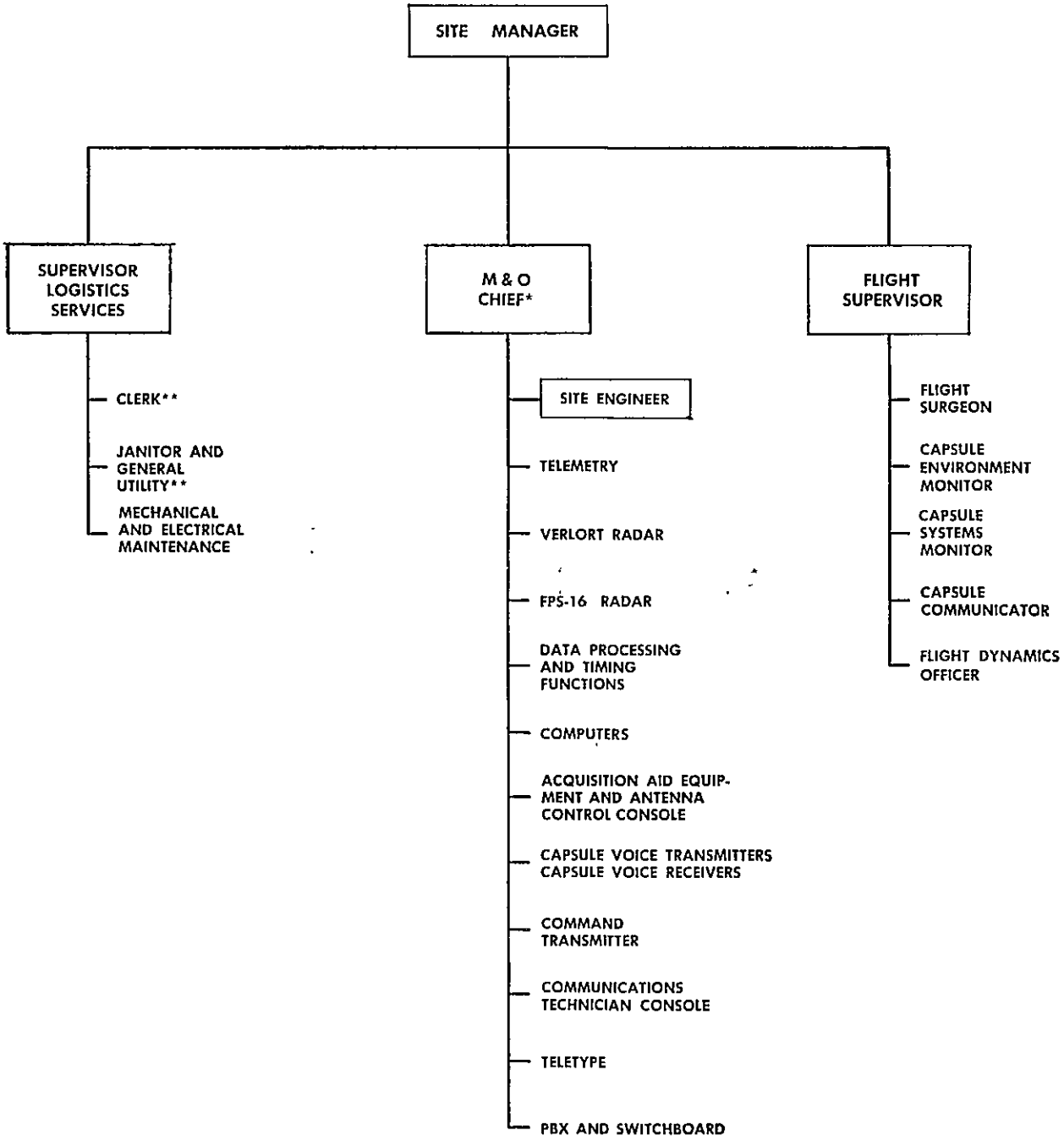


FIGURE 4-17. FLOOR PLAN, RECEIVER BUILDING—TOWN HILL



*OPERATES TECHNICIANS INTERCOM POSITION
**DURING FLIGHT OR DRILL, ASSISTS IN MESSENGER SERVICE AND MONITORS RECEIVE-ONLY TELETYPE EQUIPMENT

FIGURE 4-18. SITE ADMINISTRATION — BERMUDA

Section 5

ATLANTIC AND INDIAN OCEAN SHIPS

TABLE OF CONTENTS

Paragraph	*Title*	*Page*
5.1	Purpose of the Sites	5-1
5.2	Systems	5-1
	Ground Communications System	5-1
	Timing System	5-1
	Acquisition System	5-2
	Telemetry System	5-3
	Air-Ground Communications System	5-3
	Radar System	5-4
	Capsule Command Transmitting System	5-4
5.3	Equipment Allocations	5-4
5.4	Equipment Location	5-4
5.5	Site Administration	5-4
5.6	Geographic and Climatic Data	5-4
5.7	Transportation and Communications	5-4
5.8	Site Personnel Facilities and Services (Housing, Medical Facilities, Recreation Facilities, Mail Service, and Clothing)	5-6
5.9	Miscellaneous Information (Money, Passports, and Immunization Requirements)	5-6
5.10	Information about Ports of Call	5-6
	Mauritius	5-6
	Trinidad	5-7

LIST OF ILLUSTRATIONS

Figure	*Title*	*Page*
5-1	System Functional Block Diagram—Atlantic Ship and Indian Ocean Ship	5-9
5-2	Functional Block Diagram, Intrasite Communications System—Atlantic Ship and Indian Ocean Ship	5-10
5-3	Functional Block Diagram, Timing System—Atlantic Ship and Indian Ocean Ship	5-11
5-4	Functional Block Diagram, Acquisition System—Atlantic Ship and Indian Ocean Ship	5-12
5-5	Functional Block Diagram, Antenna System—Atlantic Ship and Indian Ocean Ship	5-13
5-6	Functional Block Diagram, Telemetry System—Atlantic Ship and Indian Ocean Ship	5-14
5-7	Functional Block Diagram, Air-Ground Communications — Atlantic Ship and Indian Ocean Ship	5-15
5-8	Area Map—Atlantic Ship and Indian Ocean Ship	5-17
5-9	Antenna and Equipment Placement—Atlantic Ship and Indian Ocean Ship	5-19
5-10	Telemetry Room—Atlantic Ship and Indian Ocean Ship	5-20
5-11	Transmitter Equipment Area—Atlantic Ship and Indian Ocean Ship	5-21
5-12	Site Administration — Atlantic Ship and Indian Ocean Ship	5-22

LIST OF TABLES

Table	*Title*	*Page*
5-1	Equipment Allocations—Atlantic Ship and Indian Ocean Ship	5-5

SECTION 5. ATLANTIC SHIP AND INDIAN OCEAN SHIP

5.1 PURPOSE OF THE SITES

In addition to the functions and systems noted in Figure 1-1 of this manual, these two sites are necessary because there are times when the capsule is beyond the range of land-based Mercury sites, and it is essential to keep periods of no communication to a minimum. These ships also provide possible alternate routing for the point-to-point ground communications network. The ships will be positioned to contact the capsule during all three passes.

5.2 SYSTEMS

See Figure 5-1 for a functional block diagram of the equipment on these ships.

5.2.1 Ground Communications System

Point-to-point high-frequency radio systems are used for communication from the ships to Goddard Space Flight Center and Cape Canaveral Control Center via intermediate land receiving stations (Figure 1-3). A type of transmission known as frequency shift carrier teletype is used. Transmitter output power is 10 kw. Radiation is by means of nondirectional vertical antennas.

Messages from the Atlantic Ship are normally sent directly to the RCA Communications station in New York for relay to Goddard and Cape Canaveral by leased facilities. The Atlantic Ship also acts as a relay station for the Canary Island site or, if necessary, the Canary Island site relays messages for the Atlantic Ship.

Transmission from the Indian Ocean Ship normally is to Perth, Australia. Both ships provide operational data and administrative information via teletype. The Atlantic Ship is equipped with dual equipment for transmission of the above information over the primary path to New York and over an alternate path by way of Grand Canary Island. The Indian Ocean Ship is equipped for communications only over the primary path to Perth, Australia.

The receiving system for both ships uses frequency and polarization diversity. A single sideband system (SSB) is used for transmitting and receiving.

An intercommunication system is provided for operational and administrative messages between Mercury personnel (Figure 5-2). Functions of particular interest in this system are the ability to:

a. Talk or monitor on the ground-air radio circuit;

b. Talk or monitor on local conference circuits;

c. Talk to the various technicians, independently of operational circuits used by the Flight Controllers.

The ships' existing intercommunications system is used for routine communications.

NOTE

The operational teletype summary from the Indian Ocean Ship passes through line-sharing equipment at Muchea, Australia, Woomera, Australia, and via submarine cable to Vancouver. A sketch of this routing appears in Figure 6-5 along with a description of line-sharing equipment.

5.2.2 Timing System

The timing system provides time correlation of data collected from the telemetry systems and a driving source for the control area time displays. The time reference used is that of Greenwich Mean Time (GMT) expressed in hours, minutes, and seconds (Figure 5-3).

A receiver is tuned to the frequency of WWV (the Bureau of Standards radio station). Signals received from this station are used as a reference standard against which a stable one-megacycle oscillator is compared and adjusted, so that the locally generated signal agrees in frequency with the incoming signal. The timing system of this site supplies various output frequencies from 1 kc to one cycle per minute by frequency dividing circuits. A check of the system is provided by a visual comparison on an oscilloscope of

the one-pulse-per-second output of the timing system and the once-per-second tone burst of WWV.

Important outputs of this system are as follows.

a. An output representing the GMT in hours, minutes, and seconds is used in the data processing and data conversion equipment to time-tag the telemetry data, and to drive certain time displays.

b. The telemetry data is time-tagged for teletype transmission. The time reference is GMT, and delivered in what is known as serial form (sequential rather than simultaneous) in a ten-pulse-per-second pulse train.

5.2.3 Acquisition System

The purpose of the acquisition system (essentially an antenna pointing device) is to aid the antennas associated with the site subsystems to acquire signals emanating from the capsule. Figure 5-4 is a functional block diagram of a typical system used on the ships. Figure 5-5 shows the antenna system interconnections.

Proper functioning of the system depends on error voltages. These voltages are developed by measurement of the time difference at which the signal transmitted by the capsule arrives at the different elements of a special antenna provided for this purpose. The magnitude of these error voltages is greater as the antenna points away from the capsule, and least when the antenna is aimed directly at the source of the signal.

The difference in arrival time of the signal at the antenna elements (phase difference) is measured by a specially designed receiver, called the acquisition aid receiver. Error voltages developed by this system are amplified and displayed on appropriate meters to aid an operator in manually correcting antenna position until antenna pointing error has been minimized. When antenna pointing is done automatically by the system, the error voltages are applied directly to the antenna pedestal, repositioning the antenna to keep it pointed at the target.

Operation of the system is somewhat different from the acquisition systems used at other Mercury sites. Equipment used in the system also differs in that additional equipment is required to correct for the varying position of the ship's antennas as the ship's course is changed.

Two types of consoles are provided for system operation at this site.

a. The *active acquisition aid control console* controls the operation of the active acquisition aid and the manual or automatic operation of the acquisition aid antenna. These types of operation are as follows.

(1) Manual operation is the control of antenna position with handwheels on the console. Visual indications are provided to show the azimuth and elevation coordinates selected with handwheels provided on this unit.

(2) Automatic operation is the control of antenna position by the active acquisition aid receiver without manual assistance. Control is accomplished by the directional-sensing capabilities of a quad-helix antenna array (on the AR-pedestal amidship), associated hybrid, and acquisition receiver. A telemetry signal is converted into antenna positioning voltages after processing through this equipment.

Signal strength meters provided on this console aid selection, for tracking purposes, of the stronger of the two telemetry frequencies transmitted by the capsule. The strength of the signal received through the acquisition aid receiver is also indicated by a signal strength meter. Error voltages, which indicate the correction voltages currently applied to the acquisition aid antenna pedestal, are displayed on this console.

b. The *acquisition data console* indicates the control mode (manual or automatic) in use by the system, and the azimuth and elevation of the various steerable antennas at the site.

Two azimuth indicators are supplied in this console for each of the two antenna pedestals. The first indicator is designated AZ TRUE (azimuth true). It is coupled to a device known as a differential synchro which combines positional information from the pedestal with positional information from the ship's gyro compass and gives a resultant positional indication that indicates antenna position in relation to true

north. The second azimuth indicator is designated AZ REL (azimuth relative) and indicates the antenna position in relation to the fixed position of the antenna base on the ship. One indicator per pedestal indicates antenna pedestal elevation.

Cablewrap indicators (lamps on the console) are also supplied to indicate when the antenna rotation is either clockwise or counterclockwise from its resting point, and towards rotational limits, which are established because of the permanent connection of antenna cable to the antenna.

During system operation, the operator receives an acquisition message which gives the expected coordinates (azimuth and elevation) and the expected time of arrival of the capsule at the ship's geographical location. Additional messages are also sent to these sites indicating the expected coordinates along the orbit, at one-minute intervals after the time of the capsule's arrival. The operator positions his handwheels until the appropriate indicators (AZ TRUE) show that the antennas are pointed toward the coordinates given in the acquisition message. While in the manual mode of operation, any deviation of the ship from its course requires readjustment of antenna position so the AZ TRUE indicator continues to show the desired coordinates. When the capsule signals are received by the active acquisition aid and manual corrections of antenna position have been made to obtain minimum error voltage indications on the appropriate meters, the active acquisition aid is placed in AUTOMATIC operation, and the antennas follow the capsule position regardless of the deviations in the ship's course. In the AUTOMATIC mode, the active acquisition aid continues to automatically track the capsule and point the antennas during the time that the capsule remains within radio range of the ships.

Since the beamwidth of the acquisition system antenna is 20 degrees, the active acquisition aid is capable of acquiring the capsule in the early stages of its pass, and of rapidly refining the antenna position so that maximum quality transmission is realized between the capsule and the ships.

5.2.4 Telemetry System

Two quad-helix antenna arrays, each on a separate pedestal, are used to obtain both height and space diversity (Figure 5-5). Four receivers are arranged in two pairs (Figure 5-6), with each pair tuned to one of two selected frequencies in the 225-260 megacycle band. The outputs of each pair of receivers are fed into a diversity combiner, a device which effectively adds the signals and improves the apparent signal-to-noise ratio. The outputs of the diversity combiners (two at each site), plus the four basic output signals from the above receivers, provide six possible sources of information. These are fed to the telemetry demodulation equipment where a manual selection is made of the signal to be demodulated. A spectrum analyzer is employed in selecting the best source of information obtained from the above equipment. These system refinements add greatly to the overall system reliability.

The received signal is complex in nature, containing three channels of frequency modulated information, plus a fourth channel that is modulated on what is termed a commutated basis, in which various information obtained by sensors in the capsule is sampled on a sequential basis.

Selected data from the above equipment is routed to various displays for monitoring during the capsule pass, and the output of each receiver and diversity combiner is recorded so that a permanent record is available. Approximately 20 quantities and notations, derived from the telemetry signals observed during the capsule transit, are incorporated into a standard format and transmitted by teletype to the Goddard Space Flight Center after the capsule has passed.

5.2.5 Air-Ground Communications System

The air-ground communications facilities at these sites use high-frequency (HF) and ultra-high-frequency (UHF) amplitude modulated (AM) voice receiving and transmitting equipment (Figure 5-7). Equipment locations are indicated on area drawings for the sites.

Receiving antennas are mounted on two steerable pedestals under control of the acquisition system, as described in paragraph 5.2.3. The UHF signals are received on the same quad-helix antenna arrays used for telemetry signal reception. However, HF signals are received by separate dipole antennas mounted on the same pedestal. The antennas mounted on the rear pedestal are used on a switching basis as transmitting antennas for the HF and UHF transmitter under control of the intercom transmitter push-to-talk switch.

The UHF receiver outputs are fed to a diversity combiner where the signals are combined to add their output strength and minimize noise. Three output signals are therefore available, receiver #1, receiver #2, and the composite signal derived from the diversity combiner. These signals are then fed to the communications technician console HF-UHF selector switch for selection of the best signal for application to the site intercom.

The HF receiver outputs are normally processed by a diversity relay actuator, which automatically selects the stronger of the incoming signals. This signal can then be compared with the UHF signal at the communications technician console, where the better signal is selected for application to the flight controller air-ground receiving network. The HF receiver outputs are also brought out directly to the communications technician console, bypassing the HF diversity relay actuator, where either receiver output can be selected as described above.

All voice communication with the capsule is recorded for future reference.

The transmitting antennas are mounted on steerable antenna pedestals under direction of the acquisition system as described above. Both HF and UHF transmitters are keyed (or operated) individually or simultaneously. All of these transmitters have an output power of approximately 100 watts.

5.2.6 Radar System

The ships are not equipped with radar, therefore, this section does not apply to these units.

5.2.7 Capsule Command Transmitting System

Since the ships are not equipped with this system, this does not apply.

5.3 EQUIPMENT ALLOCATIONS

Table 5-1 lists major equipments, grouped by system, and the manufacturer or source from whom the equipment is obtained.

5.4 EQUIPMENT LOCATION

Mercury equipment locations are designated in Figure 5-8 through Figure 5-11.

5.5 SITE ADMINISTRATION

Site administration is shown in chart form in Figure 5-12.

5.6 GEOGRAPHIC AND CLIMATIC DATA

The two ships operate in areas approximately the same distance from the equator. The climate is expected to vary from moderate to hot with periods of high humidity. Figure 5-8 shows the approximate location of both ships when at their Mercury stations.

5.7 TRANSPORTATION AND COMMUNICATIONS

The Atlantic Ship uses Trinidad for refueling and reprovisioning. Transportation to this point is provided by planes operating from an airfield associated with the range at Cape Canaveral, Florida.

The Indian Ocean Ship uses as a home port, Port Louis, Mauritius, a British colony located off the east coast of Africa in the Indian Ocean. Air service is provided on a regular biweekly basis via Paris and Nairobi. A weekly service is also provided from South Africa by South African Airways and Qantas Airways.

Communications aboard ship depend upon administrative circuits, which provide emergency communications to the United States for Mercury personnel. The usual shipboard radio facilities are also present.

TABLE 5-1

EQUIPMENT ALLOCATIONS—ATLANTIC SHIP AND INDIAN OCEAN SHIP

System	*Equipment*	*Type or Model*	*Supplied By*
Ground Communications	SSB Transmitter	GPT-10K-H	Tech. Mat. Corp.
	SSB Receiver	GPR-90X Mod.	Tech. Mat. Corp.
	Teletypewriters		
	28RO	Receive only	
	28KSR	Keyboard Send & Rec.	Teletype Corp.
	28ASR	Automatic Send & Rec.	Teletype Corp.
	28ROTR	Receive and Tape Reperforator	Teletype Corp.
Timing	F/S Tone Transmitter	101	Tele-Sig. Corp.
	Tone Receiver	102	Tele-Sig. Corp.
	Dual Diversity Comparator	110	Tele-Sig. Corp.
	Electronics Switch	109	Tele-Sig. Corp.
	Time Standard Rack Assembly		Bendix Radio
Acquisition	Active Acquisition Aid		Cubic
	Acquisition Data Console		Bendix Radio
Telemetry	Preamplifier	PR-203	Nems-Clarke
	Receiver	1434	Nems-Clarke
	Receiver	1412	Nems-Clarke
	Diversity Combiner	DCA 500	Nems-Clarke
	Decommutators—90 Channel	TDS 90	Arnoux
	Discriminators	TDA-102	Bendix Pacific
	Tape Recorder	FR-114	Ampex
Capsule Communications	Communications Technician Console	BXR-CTC-500	Bendix Radio
	Preamplifier	PR-203.S	Nems-Clarke
	HF Transmitter	CS2029	Gates
	HF Receiver	R390A/URR	Collins
	UHF Transmitter, consisting of:	AN/GRT-3	Radio Receptor
	1. UHF Transmitter	T282/GR	Radio Receptor
	2. Modulator-PWR Supply	MD-141A/GR	Radio Receptor
	Microphone Amplifier	M5167	Gates
	UHF Receiver	R-278B/GR	Collins
	Power Modulation Monitor	SG 41.1 and SG 41.2	M. C. Jones
	Tape Recorder	728	Magnacord
	Sidetone Line Amplifier	BXR-LA200	Bendix Radio

5.8 SITE PERSONNEL FACILITIES AND SERVICES

Technicians aboard the ships have officer status. They eat in the officers' salon and are quartered in staterooms apart from those of the ship's force.

Medical services are rendered by the ship's master and other maritime officers who possess first aid certificates. Each ship has a hospital room equipped with standard marine medical supplies, but no doctors are carried aboard as part of the ship's complement.

Recreational facilities include a recreation room, adjacent to the technicians' living quarters, which is provided for small games and handicraft hobbies. A regular movie schedule is maintained while at sea, and magazines and pocket books are plentiful. Ping-pong, badminton, basketball, barbells, and punching bag equipment are furnished for the more athletic. Deep sea fishing is a popular pastime. Correspondence courses are recommended as a relief from the routine of extended periods at sea.

No formal plans for mail service have been formulated at this writing. Commercial airmail service is available to Mauritius twice weekly.

Clothing recommendations for personnel assigned to duty at these sites include washable cotton short-sleeved shirts, short and long trousers, cotton sox, shower shoes, sun hat or cap, sun glasses, and a light sweater. A sports shirt and dress slacks or a light suit may also be desired for possible trips ashore. A raincoat is a necessity.

5.9 MISCELLANEOUS INFORMATION

Present arrangement for personnel assigned to these ships is to deposit the majority of personal pay in a bank specified by the individual, with a deposit slip forwarded to the individual by the bank for verification purposes. The remainder of the pay is advanced to the personnel as desired. Port Louis, Mauritius, a British colony, has a local monetary unit called the Mauritius rupee, which is equivalent to one shilling, 6 pence sterling, or 21¢ in U.S. coin. Notes are issued in denominations of 10, 5, and 1 rupees. Coins issued are half, quarter, 1, 2, 5, and 10 rupees.

Passport information is summarized in chart form in Figure 1-4 of this handbook. Additional visas may be required depending upon other calls made by these ships. Mauritius requires a medical certificate and letter of character signed by a public official before landing here.

Immunization requirements are as follows:

Small Pox—Annual;
Typhoid—Series plus annual booster;
Tetanus—Series plus annual booster;
Yellow Fever—Every 6 years;
Polio—Series, for persons under 40 years of age.

5.10 INFORMATION ABOUT PORTS OF CALL

The following information may be helpful to personnel who visit Mauritius and Trinidad during their Mercury assignments.

5.10.1 Mauritius

Lying just within the tropics, the climate is tropical-maritime during the summer and subtropical in winter, with no great extremes in temperature. Humidity is very high at or near sea level, but it is cool all year on the high central plateau. November to May is the cyclone season.

Population of the capital, Port Louis, is 72,750. The climate is considered a healthy one for Europeans, but malaria still presents some problems. Typhoid innoculations are recommended and care should be used in selection of food as there is some dysentery.

There are government hospitals, several private nursing homes, and doctors who take private patients. Drugs and medicines are expensive.

Government-controlled buses serve most parts of the island. There are plenty of taxis and the standard charge is 35¢ per mile.

Local banks are the Barclays Bank DCO, and the Mercantile Bank, Ltd.

There is one hotel in Port Louis, the Family Hotel.

Electric power is 220 volts alternating current, AC.

The official languages are English and French.

5.10.2 Trinidad

Trinidad is port of call for the Atlantic Ship. The port is seven miles from Venezuela, near the South American continent.

Climate is tropical, tempered by trade winds. Mean annual temperature ranges from 70° to 88°F. Nights are cool. Average annual rainfall ranges from 68 inches in the west to 97 inches in the east. The wet season is from June to December. The dry season is from January to May.

Europeans constitute about 3 percent of the population. English is spoken as this is a United Kingdom dependency.

The deep-water harbor is at Port-of-Spain and is served by steamship lines from all parts of the world. The international airport is at Piarco, near Port-of-Spain. Eleven airlines operate scheduled services through Trinidad.

Currency of the area is that of the British Caribbean (Eastern Group). Trinidad is included in the sterling area. The monetary unit is the West Indian dollar ($1), which divides into 100 cents.

The pound sterling equals $4.80 (West Indian) or $2.80 in U. S. currency. The U. S. dollar exchanges for $1.71 (West Indian dollar). Notes of $1, $2, $5, $10, $20, and $100 are in circulation. Local banks are the Bank of Nova Scotia, Barclays Bank DCO, Canadian Bank of Commerce, Gordon Grant and Co., Ltd., and the Royal Bank of Canada.

Hotel rates are $10 to $42 per day on the American plan (all meals).

Electric power is 115-volt, 60-cycle AC.

Light summer clothing is worn all year; raincoats must be lightweight.

Recreations include boating, yachting, golf, and tennis. There are many movie houses. Radio broadcasting is limited to the hours between 6 AM and 11 PM. SWIMMING IS CONSIDERED DANGEROUS.

Buses provide service throughout the island. Taxis can be hired at 36¢ per mile (21¢ U. S.). Gasoline prices range from 46¢ to 65¢ per gallon (27¢ to 38¢ U. S.).

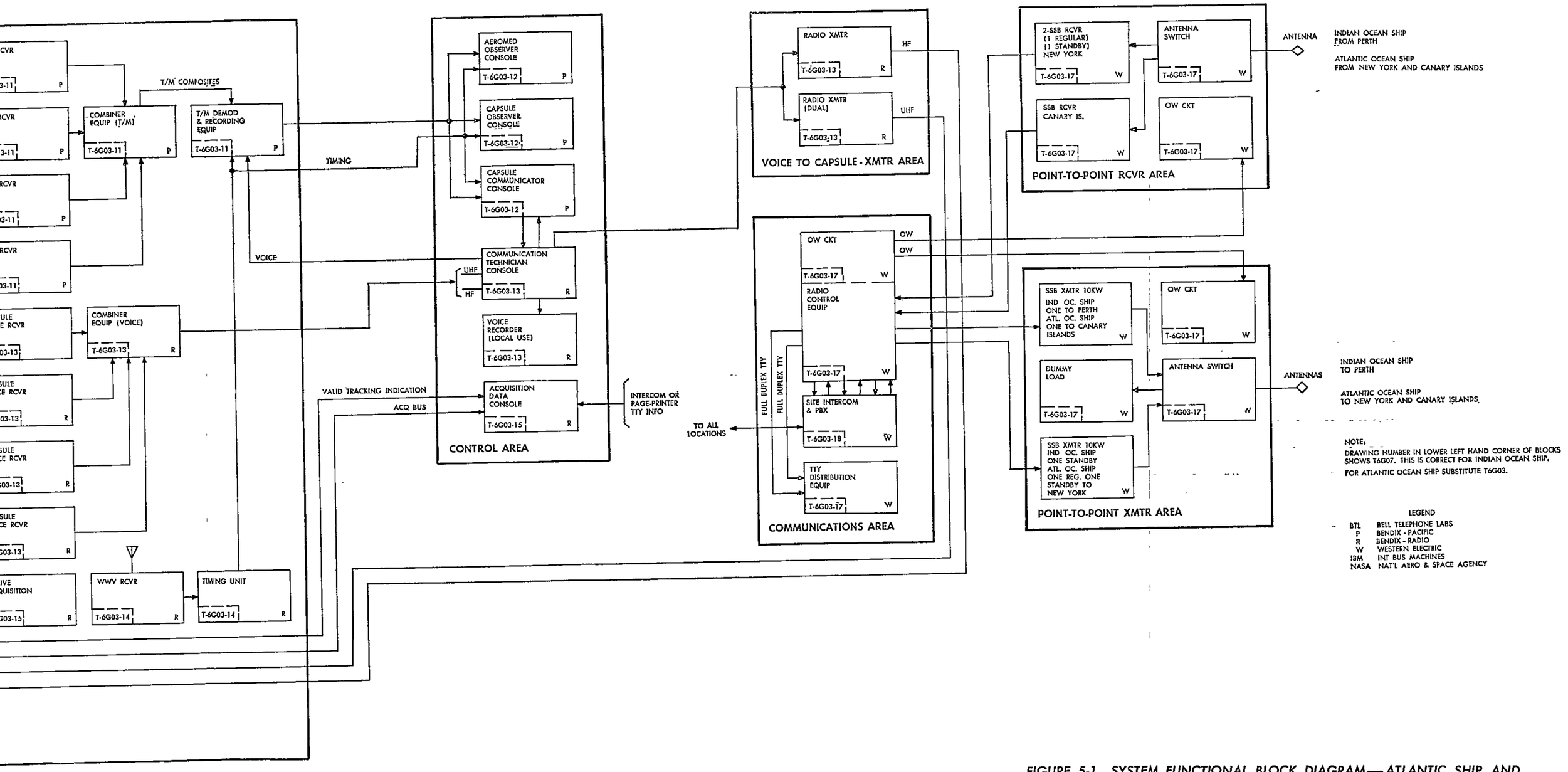


FIGURE 5-1. SYSTEM FUNCTIONAL BLOCK DIAGRAM — ATLANTIC SHIP AND INDIAN OCEAN SHIP

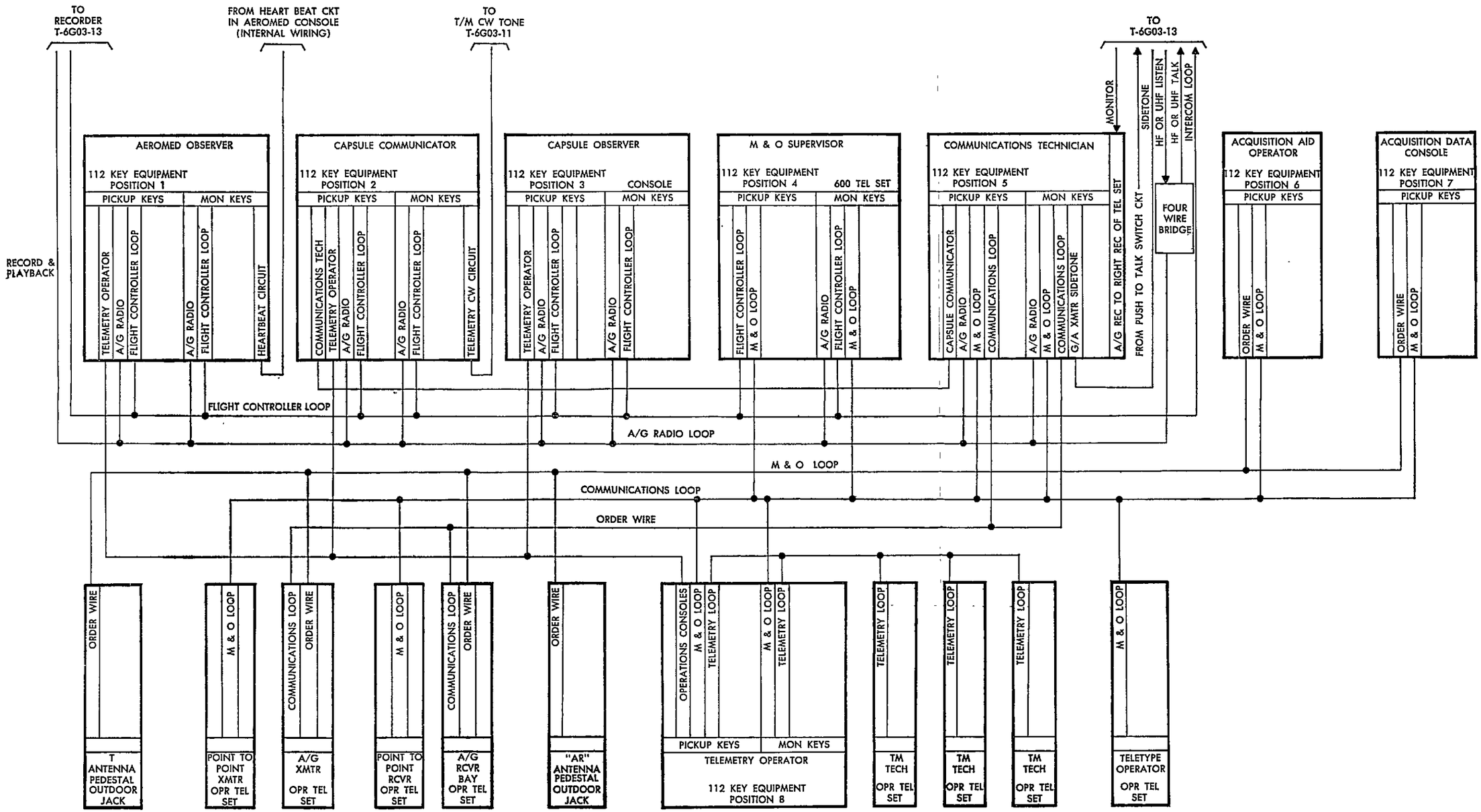


FIGURE 5-2. FUNCTIONAL BLOCK DIAGRAM, INTRASITE INTERCOMMUNICATION SYSTEM— ATLANTIC SHIP AND INDIAN OCEAN SHIP

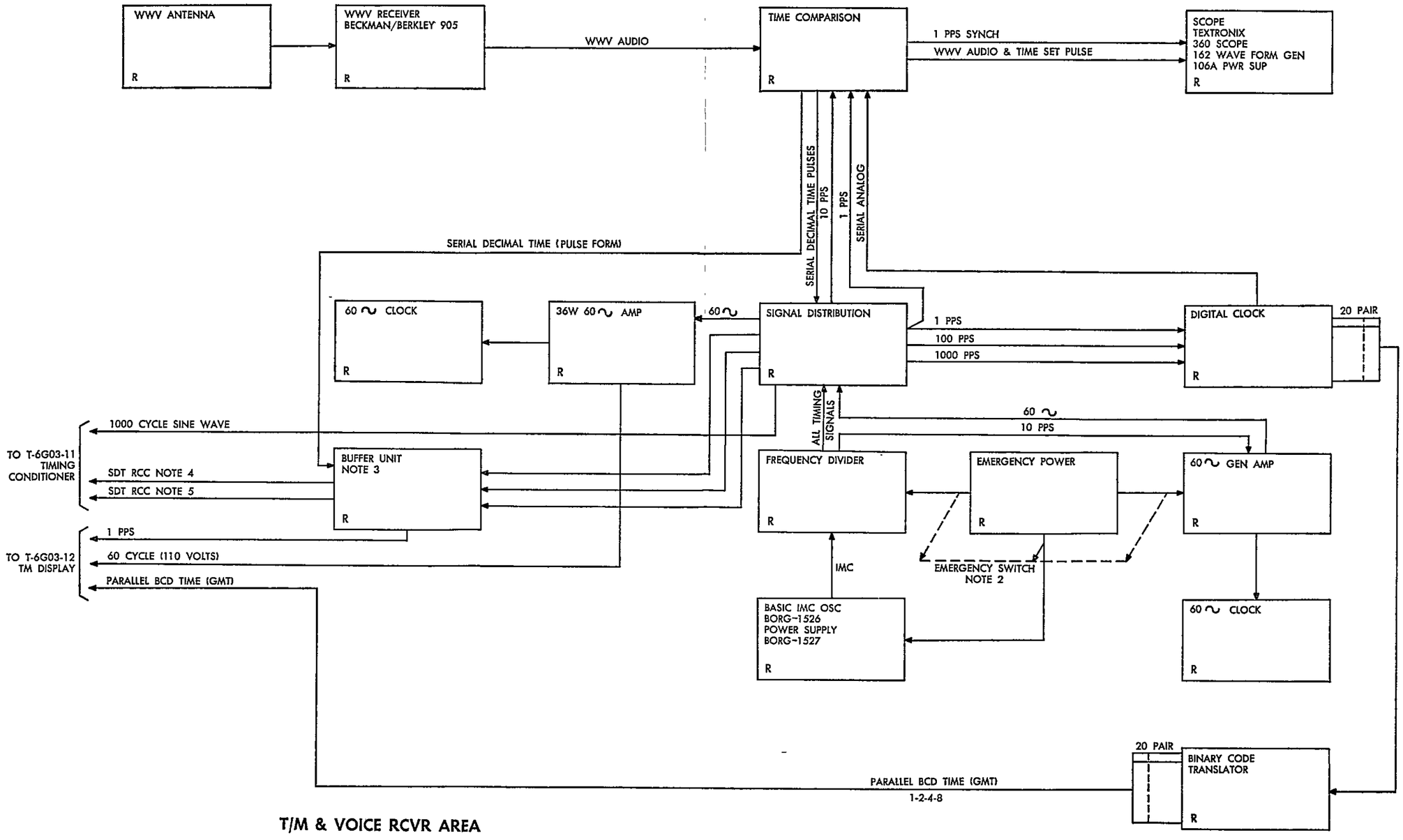


FIGURE 5-3. FUNCTIONAL BLOCK DIAGRAM, TIMING SYSTEM — ATLANTIC SHIP AND INDIAN OCEAN SHIP

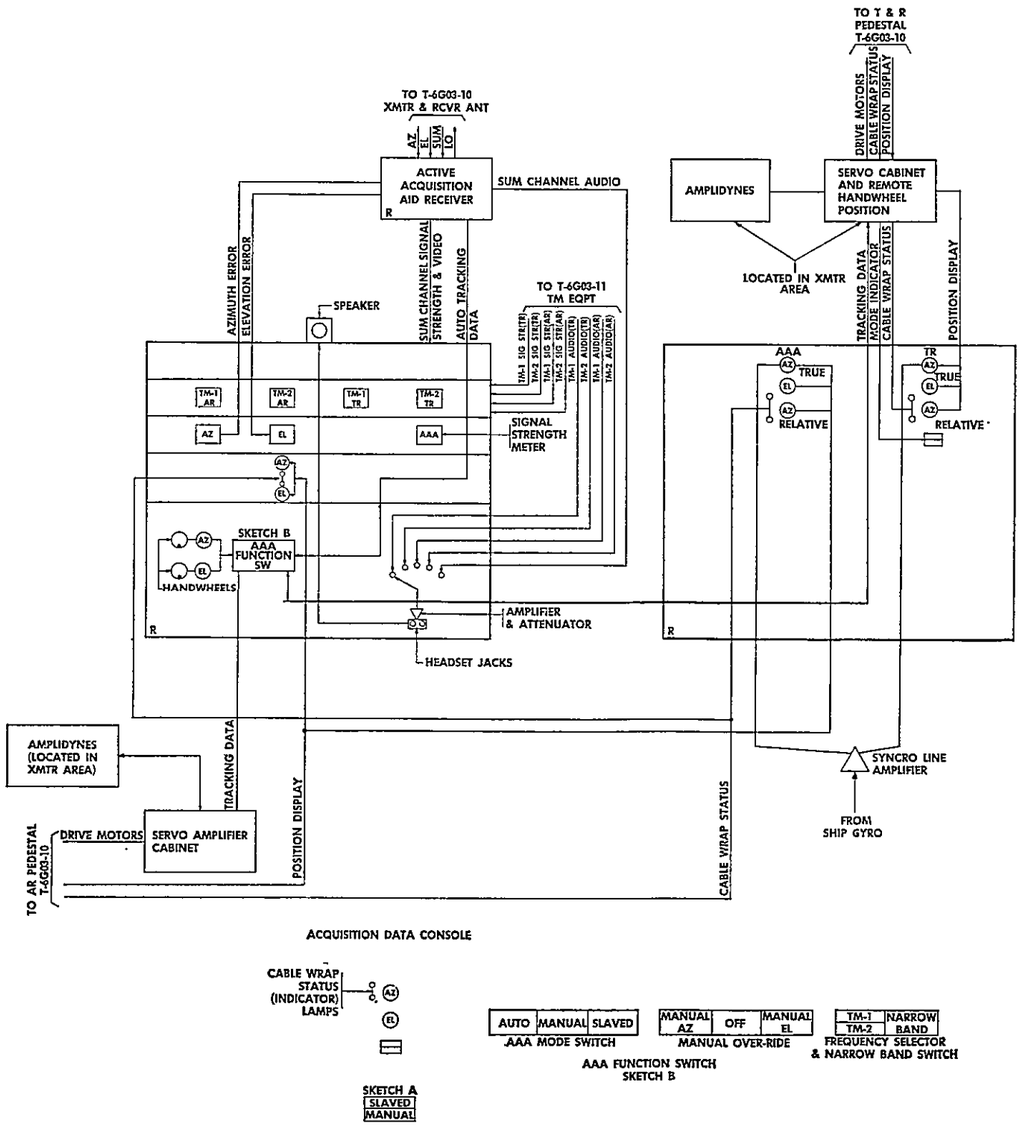


FIGURE 5-4. FUNCTIONAL BLOCK DIAGRAM, ACQUISITION SYSTEM — ATLANTIC SHIP AND INDIAN OCEAN SHIP

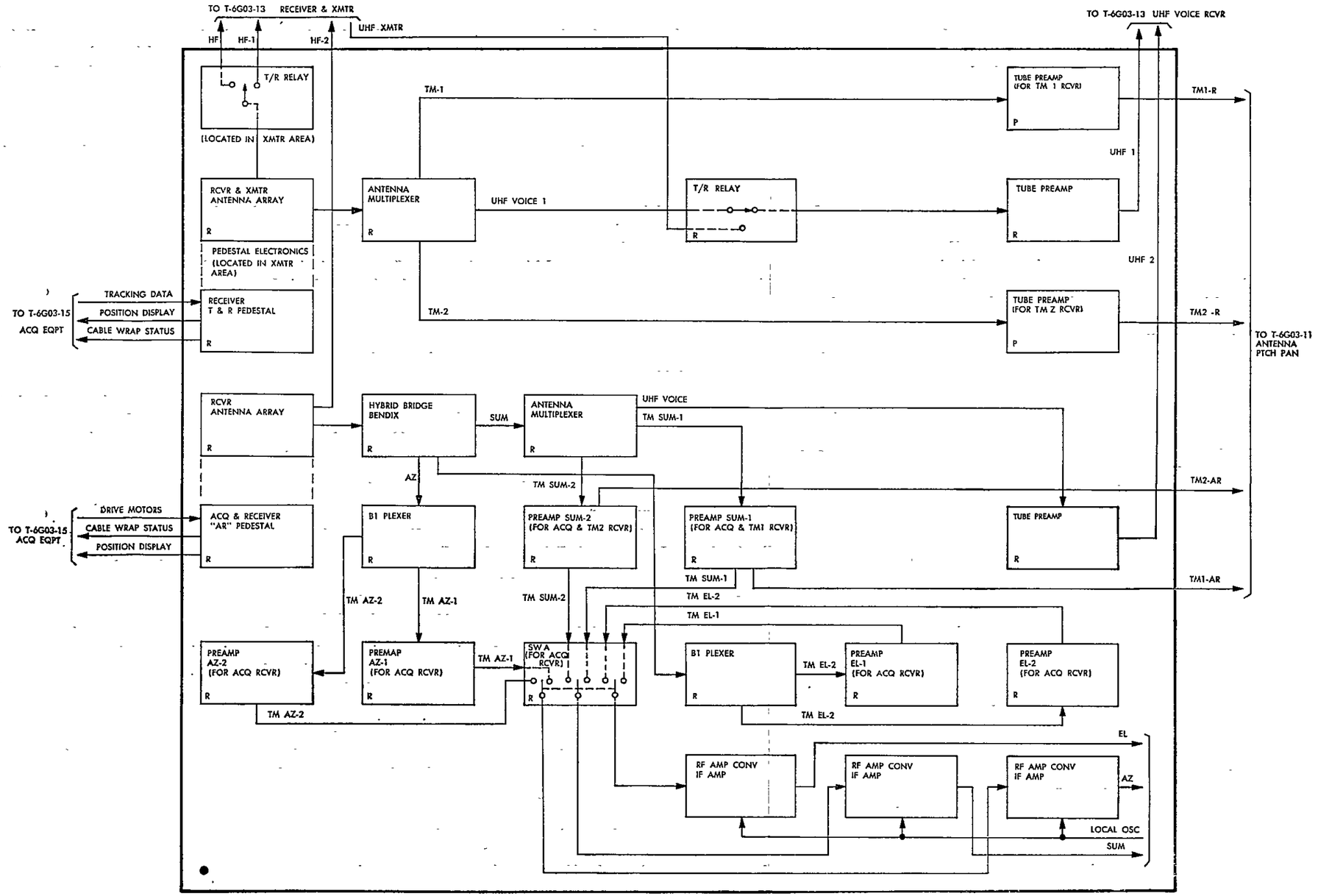


FIGURE 5-5. FUNCTIONAL BLOCK DIAGRAM, ANTENNA SYSTEM—ATLANTIC SHIP AND INDIAN OCEAN SHIP

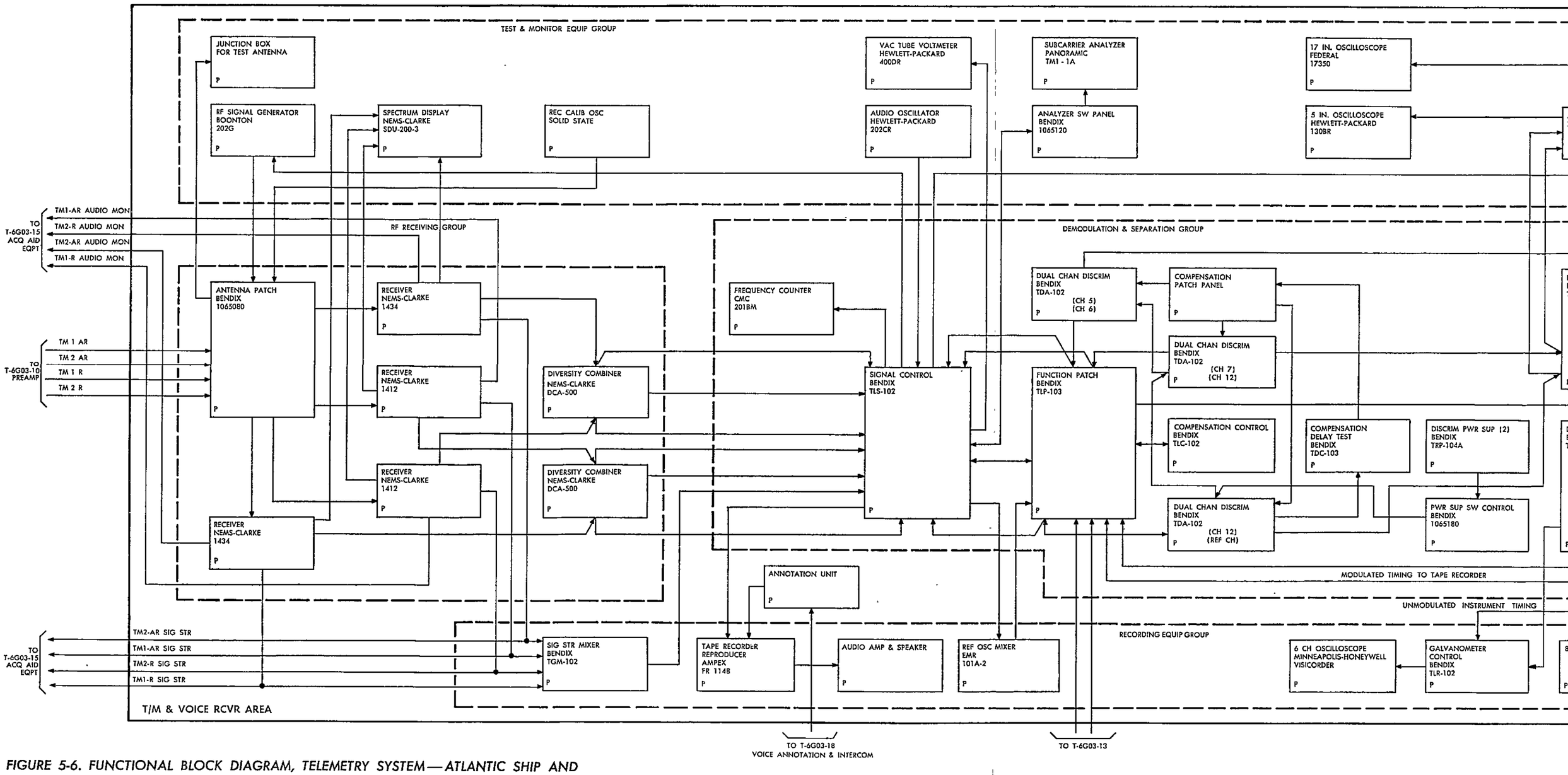


FIGURE 5-6. FUNCTIONAL BLOCK DIAGRAM, TELEMETRY SYSTEM—ATLANTIC SHIP AND INDIAN OCEAN SHIP

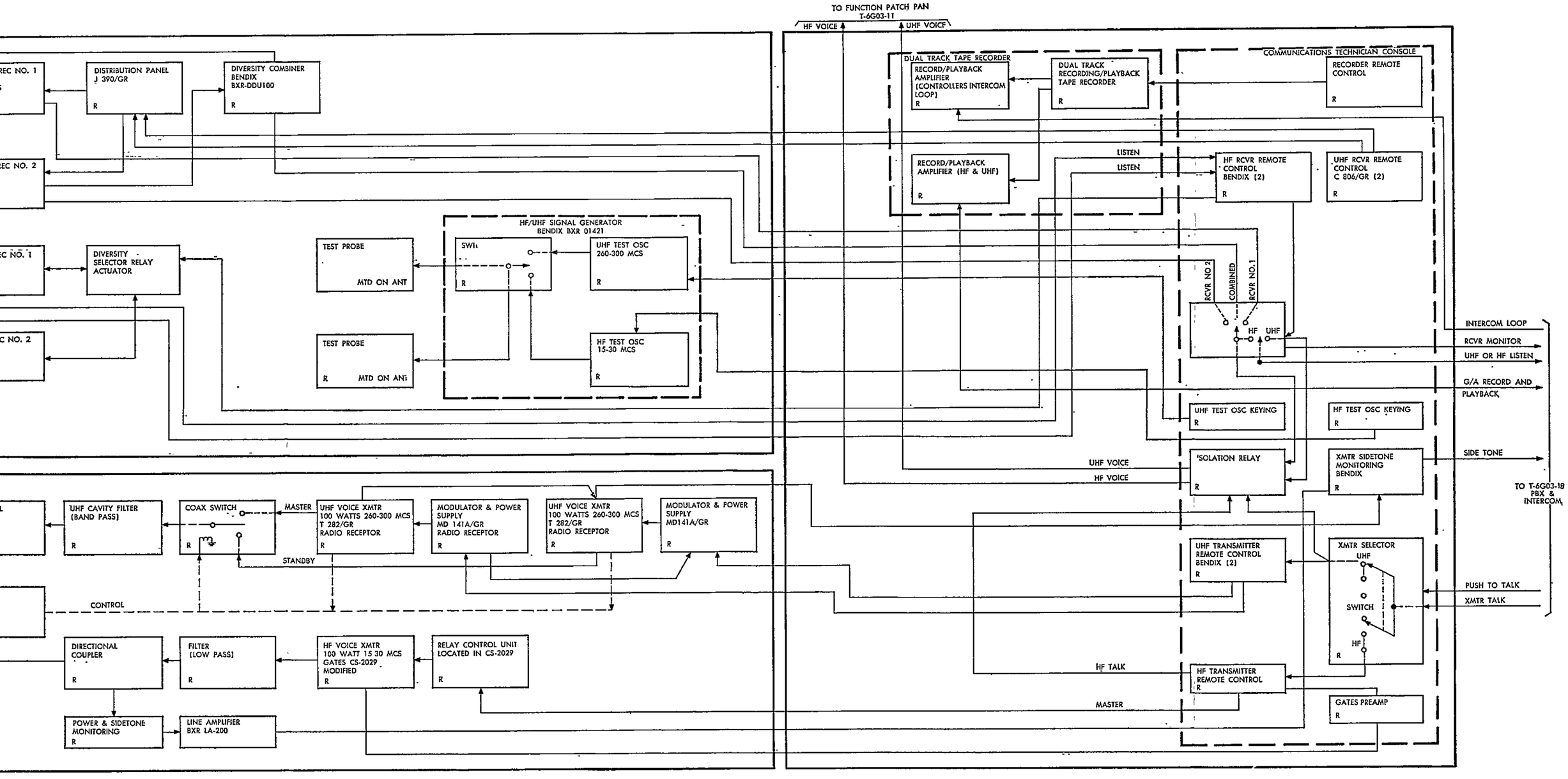


FIGURE 5-7. FUNCTIONAL BLOCK DIAGRAM, AIR-GROUND COMMUNICATIONS — ATLANTIC SHIP AND INDIAN OCEAN SHIP

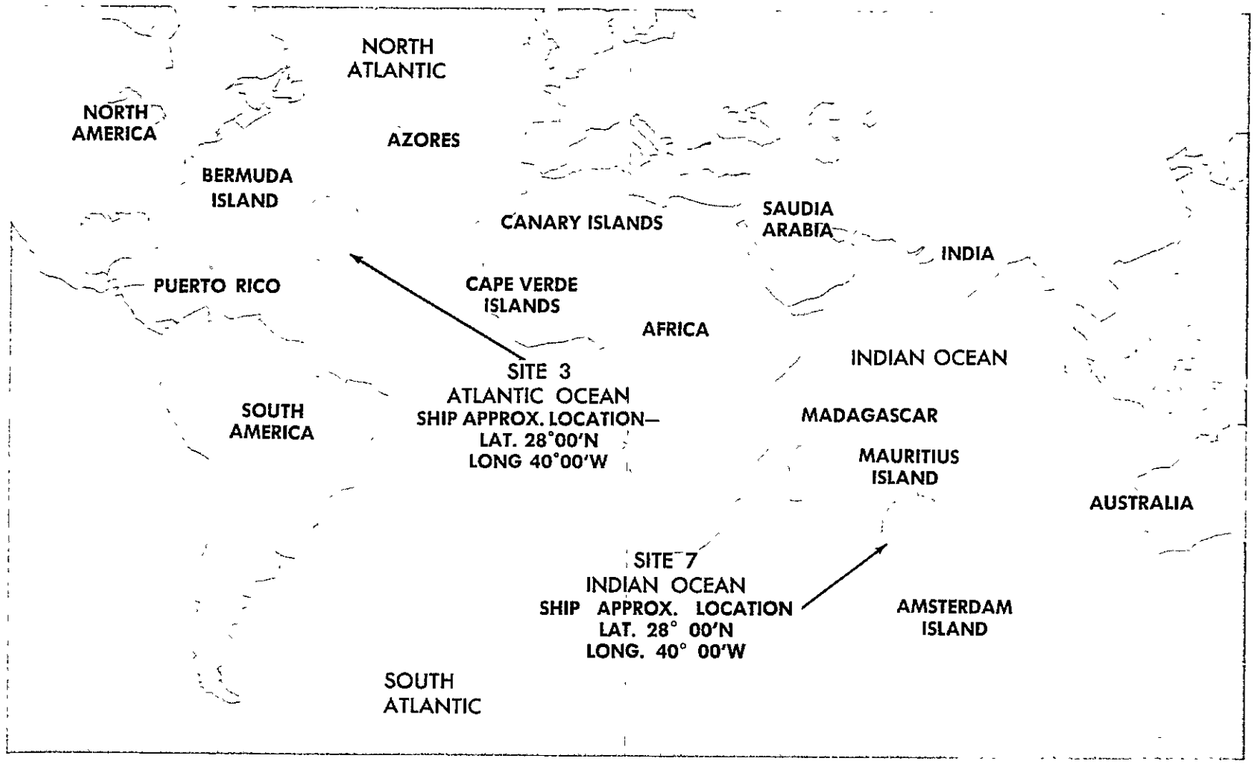
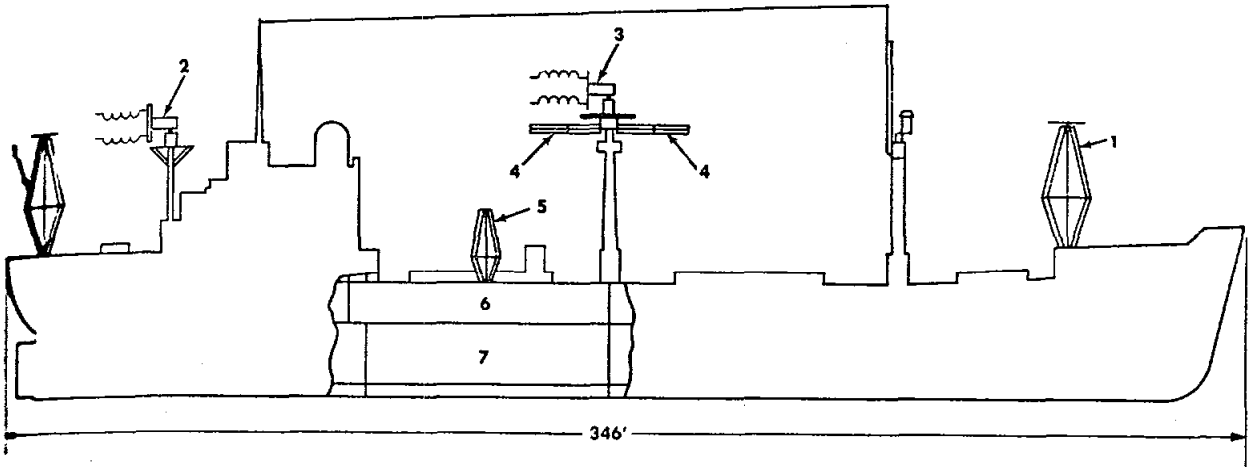


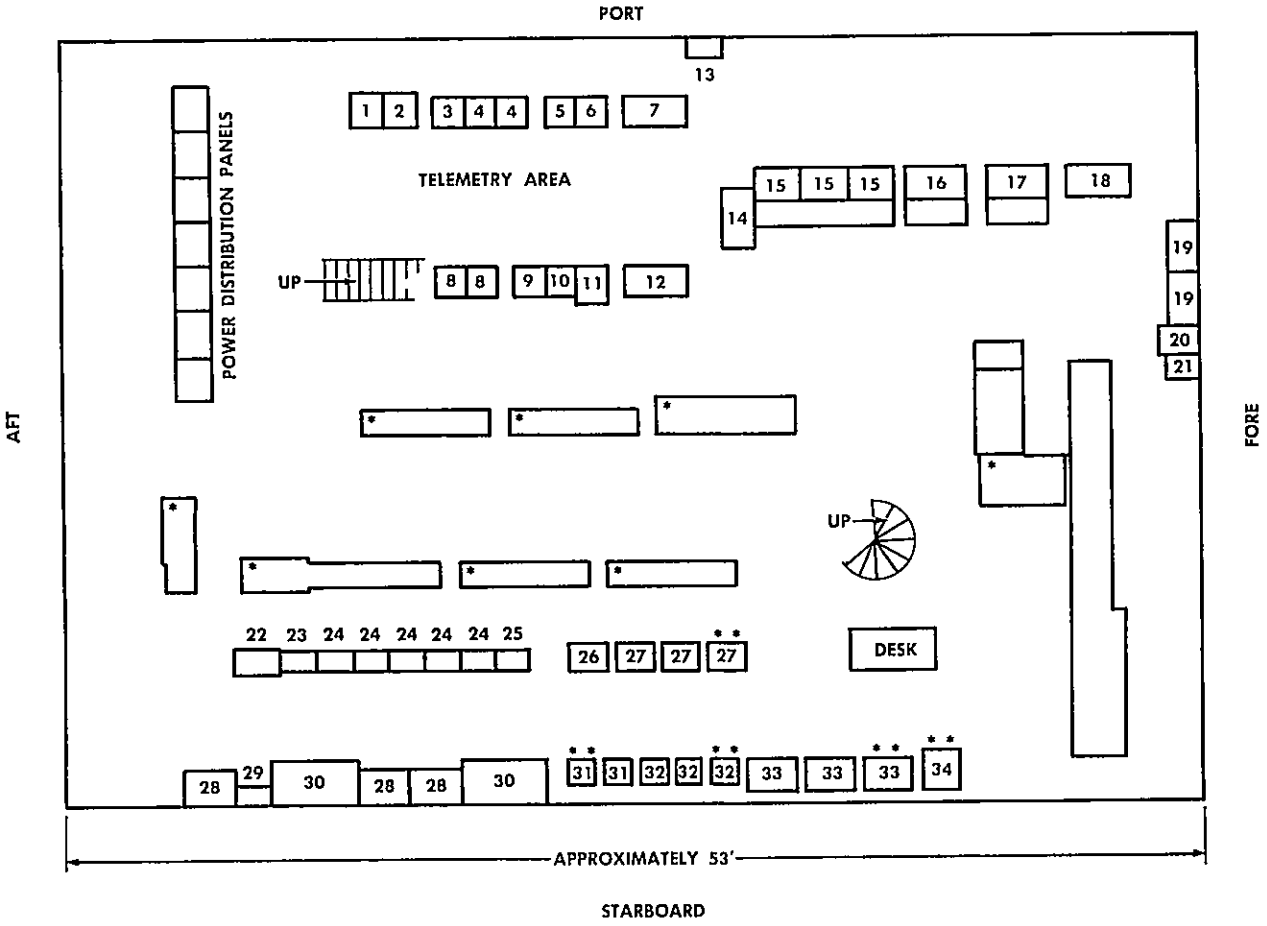
FIGURE 5-8. AREA MAP — ATLANTIC SHIP AND INDIAN OCEAN SHIP



NOTES

1. DISCONE/CAGE ANTENNA DUAL HIGH FREQUENCY POINT-TO-POINT TRANSMITTING ANTENNA
2. TRANSMITTING AND RECEIVING ANTENNA
3. RECEIVING AND ACQUISITION ANTENNA
4. HORIZONTAL CAGE RECEIVING ANTENNAS
5. CONICAL MONIPOLE RECEIVING ANTENNA, ONE ON EACH SIDE OF SHIP
6. TRANSMITTER EQUIPMENT AREA
7. TELEMETRY ROOM

FIGURE 5-9. ANTENNA AND EQUIPMENT PLACEMENT-AATLANTIC SHIP AND *INDIAN* OCEAN ***SHIP***



*EXISTING RANGE EQUIPMENT
**NOT PROVIDED ON INDIAN OCEAN SHIP

1. TAPE RECORDER
2. REPRODUCTION PRECISION
3. CONTROL
4. RECEIVERS
5. CALIBRATOR
6. DISCRIMINATOR
7. VOICE RECEIVER
8. PEN RECORDERS
9. RECORDER
10. 90/90 DECOM
11. DECOM MONITOR
12. TIMING STANDARD
13. ELECTRONIC PANEL
14. DISPLAY RECORDER
15. FLIGHT CONTROLLER CONSOLE: CAPSULE COMMUNICATOR, AEROMEDICAL MONITOR, CAPSULE MONITOR
16. COMMUNICATIONS TECHNICIAN CONSOLE
17. ACQUISITION DATA CONSOLE
18. ACQUISITION AID EQUIPMENT
19. TAPE STORAGE
20. SAFE
21. FILE
22. POWER
23. FUSE BAY
24. 112 KEY EQUIPMENT
25. DIST FRAME
26. PATCH BAY
27. DUAL DIVERSITY RECEIVERS
28. SPARE PARTS CABINET
29. ELECTRONIC PANEL
30. WORK BENCH
31. 28RO
32. 28KSR
33. 28ASR
34. 28ROTR

FIGURE 5-10. TELEMETRY ROOM—ATLANTIC SHIP AND INDIAN OCEAN SHIP

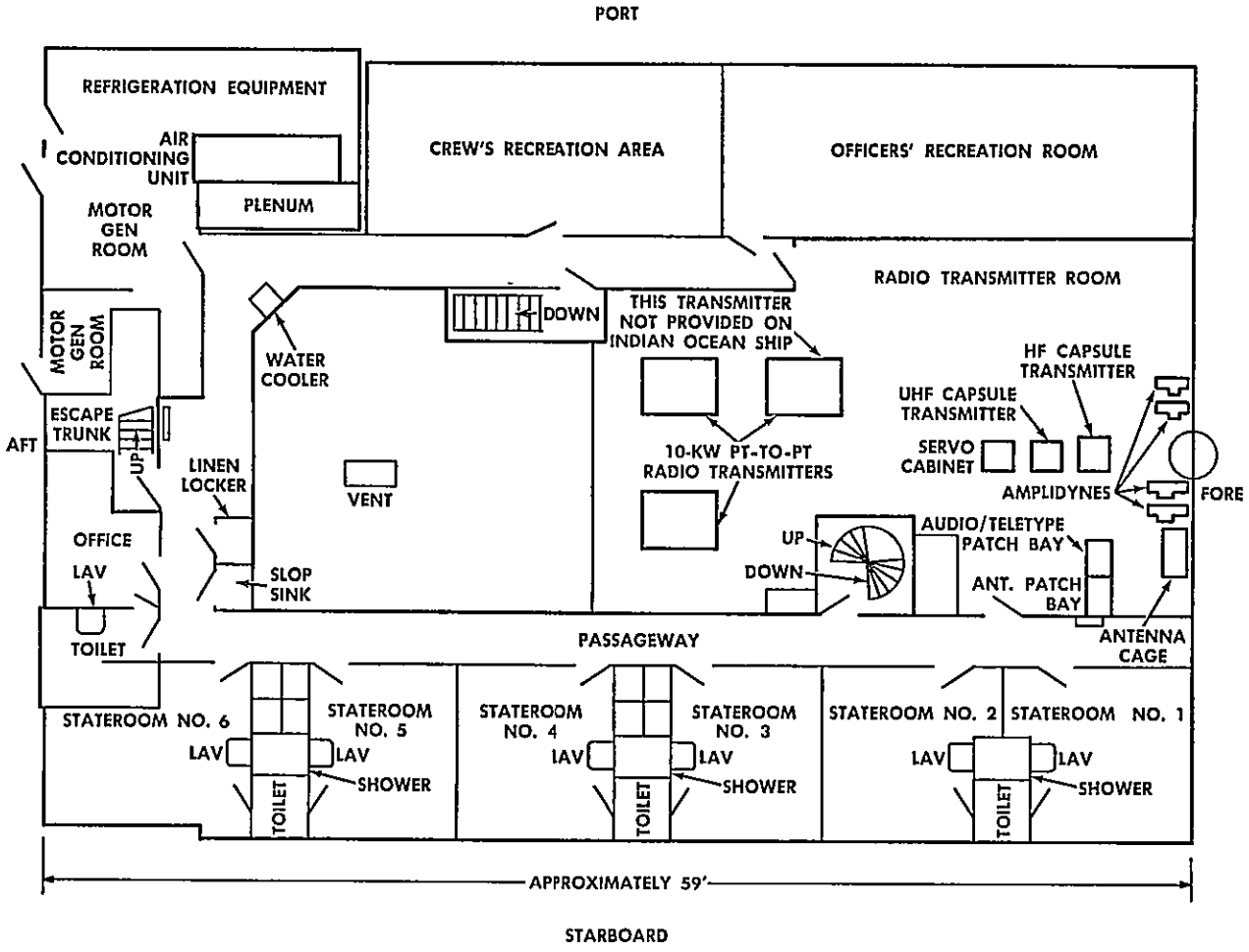
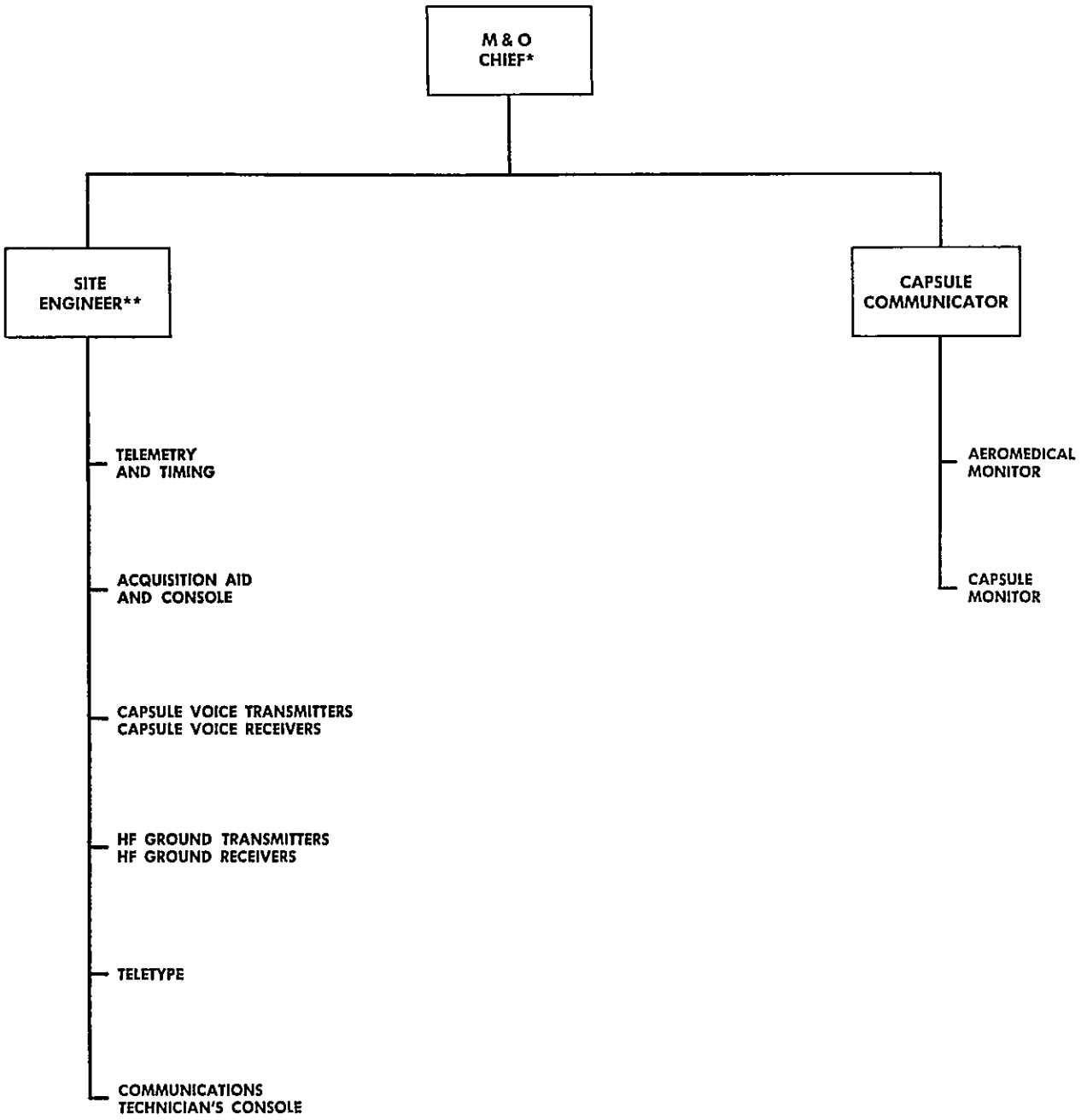


FIGURE 5-11. TRANSMITTER EQUIPMENT AREA—ATLANTIC SHIP AND INDIAN OCEAN SHIP



*OPERATES TECHNICIANS INTERCOM POSITION
**MAINTAINS AND OPERATES ACQUISITION AID AND CONSOLE

FIGURE 5-12. SITE ADMINISTRATION— ATLANTIC SHIP AND INDIAN OCEAN SHIP

Section 6

GRAND CANARY ISLAND, MUCHEA WOOMERA, GUAYMAS, AND CORPUS CHRISTI

TABLE OF CONTENTS

Paragraph	*Title*	*Page*
6.1	Purpose of the Sites	6-1
6.2	Systems	6-1
	Ground Communications System	6-1
	Timing System	6-2
	Acquisition System	6-2
	Telemetry System	6-4
	Capsule Communications System	6-4
	Radar System	6-5
	Command Transmitting System	6-5
6.3	Equipment Allocations	6-5
6.4	Equipment Locations	6-5
6.5	Site Administration	6-7
6.6	Geographic and Climatic Data	6-7
	Grand Canary Island	6-7
	Muchea, Australia	6-7
	Woomera, Australia	6-7
	Guaymas, Mexico	6-7
	Corpus Christi, Texas	6-7
6.7	Transportation and Communications	6-8
	Grand Canary Island	6-8
	Muchea, Australia	6-8
	Woomera, Australia	6-8
	Guaymas, Mexico	6-8
	Corpus Christi, Texas	6-9
6.8	Site Personnel Facilities and Services (Housing, Medical Facilities, Recreational Facilities, Mail Service, Religious Facilities, Clothing, and Food)	6-9
	Grand Canary Island	6-10
	Muchea, Australia	6-10
	Woomera, Australia	6-10
	Guaymas, Mexico	6-11
	Corpus Christi, Texas	6-11
6.9	Miscellaneous Information (Money, Taxes, Passport, Visa, and Immunization Requirements)	6-12
	Grand Canary Island	6-12
	Muchea, Australia	6-12
	Woomera, Australia	6-12
	Guaymas, Mexico	6-12
	Corpus Christi, Texas	6-14

LIST OF ILLUSTRATIONS

Figure	Title	Page
6-1	Master Functional Block Diagram —Muchea and Guaymas	6-15
6-2	Master Functional Block Diagram —Grand Canary Island	6-16
6-3	Master Functional Block Diagram —Woomera, Australia	6-17
6-4	Master Functional Block Diagram —Corpus Christi, Texas	6-18
6-5	Ground Communications, Teletypewriter Line-Sharing Layout	6-19
6-6	Block Diagram, Typical Timing System	6-21
6-7	Block Diagram, Acquisition System	6-22
6-8	Functional Block Diagram, Telemetry System—Grand Canary Island, Woomera, and Corpus Christi	6-23
6-9	Functional Block Diagram, Telemetry System — Muchea and Guaymas	6-24
6-10	Air-Ground Communications Facilities—Grand Canary Island	6-25
6-11	Air-Ground Communications Facilities—Muchea	6-26
6-12	Air-Ground Communications Facilities — Woomera and Corpus Christi	6-27
6-13	Air-Ground Communications Facilities—Guaymas	6-28
6-14	Functional Block Diagram, Radar System—Grand Canary Island	6-29
6-15	Functional Block Diagram, Radar System—Muchea, Guaymas, and Corpus Christi	6-30
6-16	Functional Block Diagram, Radar System—Woomera	6-31
6-17	Area Map—Grand Canary Island	6-33
6-18	Site Plan—Grand Canary Island	6-34
6-19	Floor Plan—Grand Canary Island	6-35
6-20	Verlort Radar Van—Grand Canary Island, Guaymas, Kauai, and Corpus Christi	6-36
6-21	Area Map — Muchea and Woomera	6-37
6-22	Site Plan—Muchea	6-38
6-23	Floor Plan, Telemetry and Control Area—Muchea	6-39
6-24	Transmitter Van — Muchea and Guaymas	6-40
6-25	Site Plan—Woomera, Australia	6-41
6-26	Floor Plan, Telemetry and Control Area—Woomera	6-42
6-27	Transmitter Van—Grand Canary Island, Woomera, Point Arguello, and Corpus Christi	6-43
6-28	Area Map—Guaymas	6-44
6-29	Site Plan—Guaymas	6-45
6-30	Floor Plan, Telemetry and Control Area—Guaymas	6-46
6-31	Area Map—Corpus Christi	6-47
6-32	Rodd Field, Showing Mercury Areas	6-48
6-33	Telemetry and Control Area—Corpus Christi	6-49
6-34	Site Administration	6-50

LIST OF TABLES

Table	Title	Page
6-1	Equipment Allocations — Grand Canary Island; Muchea, Australia; Woomera, Australia; Guaymas, Mexico; Corpus Christi, Texas	6-6

SECTION 6. GRAND CANARY ISLAND; MUCHEA, AUSTRALIA; WOOMERA, AUSTRALIA; GUAYMAS, MEXICO; CORPUS CHRISTI, TEXAS

6.1 PURPOSE OF THE SITES

In addition to the functions and systems noted in Figure 1-4 of this manual, the sites are important to Project Mercury for the following reasons.

a. Grand Canary Island is necessary for tracking purposes should the capsule flight be aborted in the latter stages of the launching and pass beyond the range of the Bermuda tracking radars. Data acquired at this station can aid materially in computing the impact point of a capsule flight aborted at this time.

b. Muchea, Australia, is located at the approximate midpoint of an orbit and possesses command radio facilities as well as radar tracking capabilities. Inasmuch as radar tracking data is used to continually refine orbital parameter data predicted by the computing station (Goddard), data obtained from Muchea is most useful in correcting computer predictions, due to capsule deviation from the predicted path.

Figures illustrating the overall instrumentation of the sites covered in this section are as follows.

Figure 6-1 Master Functional Block Diagram—Muchea and Guaymas.
Figure 6-2 Master Functional Block Diagram—Grand Canary Island.
Figure 6-3 Master Functional Block Diagram—Woomera.
Figure 6-4 Master Functional Block Diagram—Corpus Christi.

6.2 SYSTEMS

6.2.1 Ground Communications System

Figure 1-3 illustrates the world-wide network of Project Mercury which is used to communicate with the Goddard communications and computing center and the Mercury Control Center at Cape Canaveral. Figure 1-2 indicates intercommunication facilities for a completely instrumented site, but is applicable to all sites, by excluding those subsystems and associated connections which are not supplied at a particular site.

Communications facilities between Grand Canary Island and London are leased from Trans Radio Española, located at San Lorenzo, Gran Canaria. Data from this site is then sent via the Atlantic cable to New York and via leased facilities to Goddard and Cape Canaveral.

All communications facilities at Australia are leased from the Australian Post Office Authority.

Primary communications facilities from Guaymas, Mexico, and Corpus Christi, Texas, are by leased facilities. Secondary facilities via other types of facilities (radio, etc.) may be provided at a later time if deemed necessary for increased reliability or other reasons.

Line-sharing equipment is provided at Muchea and Woomera to reduce the requirements for intersite teletype transmission facilities, and to provide an emergency path for each station, should a primary path fail. Line-sharing equipment accepts messages from various sites, stores them until the facilities to the message destination are idle, and then transmits them on a sequential basis.

The basic arrangement of the circuits through this equipment and various sites which share the facilities is shown in Figure 6-5.

Units required for each message channel are teletype tape reperforators, which place the incoming message on a tape for temporary storage, and a transmitter which reads the stored message from the same tape and forwards it as soon as the line facilities become idle. Additional controlling relays are provided for transmitting the waiting messages on a sequential basis, as well as alarm circuits to indicate a malfunction of the equipment.

Equipment supplied at Muchea consists of a reperforator and transmitter for messages relayed through this point from the Indian Ocean Ship, another reperforator-transmitter combination for nonradar messages from Muchea, and a spare reperforator-transmitter for emergency use.

Woomera is equipped with two complete installations as enumerated for Muchea. The first installation handles message traffic as follows: one reperforator-transmitter combination processes nonradar messages from the Woomera site; the second reperforator-transmitter combination processes the S-band radar messages from Muchea; a spare reperforator-transmitter combination is supplied. The second installation at Woomera handles message traffic as follows: one reperforator-transmitter processes Woomera radar data; the second reperforator-transmitter processes the messages received from the line-sharing equipment at Muchea; a spare reperforator-transmitter is provided.

Manual patching provides a high degree of flexibility in handling the messages passing through these stations. Should cable facilities be in trouble between locations, the remaining facilities may be used in conjunction with the above equipment.

6.2.2 Timing System

The timing system provides time correlation of data collected from radar and telemetry systems, and it provides a driving source for the control area time displays (Figure 6-6). The time reference used is that of Greenwich Mean Time (GMT) expressed in hours, minutes, and seconds.

A receiver is tuned to the frequency of WWV (the Bureau of Standards radio station). Signals received from this station are used as a reference standard against which a stable one-megacycle oscillator is compared and adjusted, so that the oscillator frequency agrees with the frequency of the incoming signal. This comparison is accomplished at a convenient point in the circuits of the site's timing system, which supplies various output frequencies from 1 kc to one cycle per minute by frequency dividing circuits. A check of the system is provided by visually comparing, on an oscilloscope, the one-pulse-per-second output of the timing system and the once-per-second tone burst of WWV.

Important outputs of this system are as follows.

a. An output representing the GMT in hours, minutes, and seconds, is used in the data processing and data conversion equipment to time-tag radar data, and to drive certain time displays.

b. A pulse from the timing equipment every six seconds causes radar data to be read out.

c. The telemetry data is time-tagged for teletype transmission. The time reference is GMT, which is delivered in the serial form (sequential rather than simultaneous) in a ten-pulse-per-second pulse train.

6.2.3 Acquisition System

The function of the acquisition system (essentially an antenna pointing device) is to aid the antennas associated with the site subsystems to acquire signals emanating from the capsule (Figure 6-7).

Proper functioning of the system depends on error voltages. These voltages are developed by measurement of the time difference at which the signal transmitted by the capsule arrives at the different elements of a special antenna provided for this purpose. The magnitude of these error voltages is greater as the antenna points away from the capsule and is least when the antenna is aimed directly at the source of the signal.

The difference in arrival time of the signal at the antenna elements (phase difference) is measured by an acquisition aid receiver which is designed for this purpose.

Error voltages developed by this system are amplified and displayed on appropriate meters to aid a system operator in manually correcting the antenna position until antenna pointing error is at a minimum, as evidenced by minimum error voltage indications. When the antenna pointing is done automatically by the

system, the error voltages are applied directly to the antenna pedestal, repositioning the antenna to keep it pointed at the target.

Two types of consoles are provided for system operation at these sites.

a. The *active acquisition aid control console* controls the operation of the active acquisition aid and the manual, automatic, or slaved operation of the acquisition aid antenna. These types of operation are as follows.

(1) Manual operation is the control of antenna position with handwheels on the console. Visual indications are provided to show the azimuth and elevation coordinates selected with handwheels provided on this unit.

(2) Automatic operation is the control of antenna position by the active acquisition aid receiver without manual assistance. Control is accomplished by the directional-sensing capabilities of a quad-helix antenna array (on the AR-pedestal), associated hybrid, and acquisition receiver. A telemetry signal is converted into antenna positioning voltages after processing through this equipment.

(3) Slaved operation is the control of the acquisition aid antenna by positioning voltages supplied by other antennas on the site, as from the radar antennas.

Signal strength meters provided on this console aid selection of the stronger of the two telemetry frequencies transmitted by the capsule. The strength of the signal received through the acquisition aid receiver is also indicated by a signal strength meter. Error voltages, indicating the correction voltages applied to the acquisition aid antenna pedestal, are displayed on this console.

b. The *acquisition data console* indicates the control mode (manual, automatic, or slaved) and the azimuth and elevation of the various steerable antennas at the site. The acquisition data console allows any of the steerable antennas at the site to be slaved to the source furnishing the most accurate tracking information. Cablewrap indicators (lamps on the console) are also supplied to indicate when antenna rotation is either clockwise or counterclockwise from its resting point, and towards rotational limits which are established because of the permanent connection of antenna cable to the antenna. "Valid tracking" lamps are also supplied. Their function is in the description of system operation.

Since the acquisition aid antenna receiving pattern has a 20-degree beamwidth, the acquisition system is capable of acquiring the target early and furnishing refined capsule position information to all other steerable antenna pedestals at the site. Since the area to be searched has been greatly decreased, radar equipments with beamwidths of less than 3 degrees may now acquire the target more readily.

During system operation the operator receives an acquisition message which gives the expected coordinates (azimuth and elevation) and the expected time of arrival of the capsule at the site's geographical location. Additional messages also sent to these sites indicate the expected coordinates at one-minute intervals after the time of the capsule's arrival. The operator positions his handwheels until the appropriate indicators show that the antennas are pointed toward the coordinates given in the acquisition message. When the capsule signals are received by the system, manual corrections of antenna position are made to obtain minimum error voltage indications on the appropriate meters. The system is then placed in AUTOMATIC operation, and the antennas follow the capsule position automatically.

While in the automatic mode of operation, the system continues to automatically track the capsule while the capsule remains within radio range of the sites.

Valid tracking signals (lamps on the acquisition data console) are lighted to indicate when either type of radar is tracking the capsule automatically. The acquisition data console operator can then select the radar to control the aiming of the other site antennas through a master control circuit provided in the system. This control circuit causes all antennas under

control of the system to follow or slave to the control source chosen by the Acquisition Data Console Operator. The acquisition system also continues to track the capsule throughout the pass, so that control of the site antennas can be restored to the active acquisition aid if the radar should lose the capsule at any time.

6.2.4 Telemetry System

Functional block diagrams provided for the telemetry systems at these sites are:

Figure 6-8—Grand Canary Island
Woomera
Corpus Christi

Figure 6-9—Muchea
Guaymas

System operation is as follows.

Two quad-helix antenna arrays, each located on a separate pedestal, are used to obtain both height and space diversity. Four receivers are arranged in two pairs, with each pair tuned to one of two selected frequencies in the 225-260 megacycle band. The outputs of each pair of receivers are fed into a diversity combiner, a device which effectively adds the signals and improves the apparent signal-to-noise ratio. The outputs of the diversity combiner (two at each site) plus the four basic output signals from the above receivers provide six possible sources of information. These are fed to the telemetry demodulation equipment where a manual selection is made of the signal to be demodulated. A spectrum analyzer is employed in selecting the best source of information obtained from the above equipment. These system refinements add greatly to the overall system reliability.

Selected data from the above equipment is routed to various displays for monitoring during the capsule pass, and the output of each receiver and diversity combiner is recorded for a permanent record. Approximately 20 quantities and notations, derived from the telemetry signals observed during the capsule transit are incorporated into a standard format and transmitted via teletype to the Goddard Space Flight Center after the capsule has passed.

6.2.5 Capsule Communications System

Air-ground communications facilities at these sites use high-frequency (HF) and ultra-high-frequency (UHF) voice receiving and transmitting amplitude modulated equipment. See Figures 6-10 through 6-13 for system block diagrams. Equipment locations are indicated on area drawings for the sites.

NOTE

The receiving system is the same for all of the above sites.

Receiving antennas are mounted on steerable pedestals under control of the acquisition system, as described in paragraph 6.2.3. The UHF signals are received on the same quad-helix antenna arrays used for telemetry signal reception. The HF signals are received by separate dipole antennas, which are mounted on the same pedestals as the UHF antennas. The UHF receiver outputs are fed to a diversity combiner where the signals are combined to add their output strength and minimize noise. The three output signals available are receiver #1, receiver #2, and the composite signal derived from the diversity combiner. These three signals are then fed to the communications technician console HF-UHF selector switch. The best signal is selected and applied to the site intercom. The HF receiver outputs are normally processed by a diversity relay actuator, which automatically selects the stronger of the incoming signals. This signal is compared with the UHF signal at the communications technician console, where the better signal is selected for application to the flight controller air-ground receiving network. The HF receiver outputs also are brought directly to the communications technician console, bypassing the HF diversity relay actuator, where either receiver output can be selected as described above.

All voice communication with the capsule is recorded for future reference.

The transmitting antennas are mounted on a steerable antenna pedestal under direction of the acquisition system as described above. Both HF and UHF transmitters can be keyed (or operated) either individually or simultaneously.

Transmitting systems at Grand Canary Island, Woomera, and Corpus Christi are practically identical and differ only in that Grand Canary Island has a standby HF transmitter. All of these transmitters have an output power of approximately 100 watts. The standby HF transmitter at Grand Canary is used for recovery communication with the capsule.

6.2.6 Radar System

Functional system block diagrams are provided for these sites as follows:

Figure 6-14—Grand Canary Island
Figure 6-15—Muchea
Guaymas
Corpus Christi
Figure 6-16—Woomera

NOTE

The radar at Woomera is an FPS-16 (C-band). The other four sites are equipped with Verlort (S-band) type radar.

The Verlort radar supplies precise tracking data within its nominal range of 700 miles. After processing by conversion equipment, this data is sent via teletype to the Goddard Space Flight Center. In addition, this radar is used as a controlling source by the acquisition system for pointing the other antennas at the site, when the radar operator signifies, by a valid tracking signal, that the radar is effectively and accurately tracking the capsule. This function is explained in paragraph 6.2.3.

The FPS-16 radar has a very narrow antenna beamwidth and is capable of providing very precise tracking data throughout its nominal 500-mile range. Data from this radar must also be converted to a teletype form for transmission via teletype to the Goddard Space Flight Center. This radar is also incorporated into the acquisition system, both as a directed and as a directing unit, as explained in paragraph 6.2.3.

6.2.7 Command Transmitting System

Additional transmitting air-ground equipment is provided at Muchea and Guaymas for command radio purposes, that is, to transmit commands from the sites to the capsule (Figures 6-11, 6-13, 6-24). These commands initiate or modify certain programmed events within the capsule, including firing of the retrorockets to initiate reentry of the capsule into the atmosphere, and resetting the clocks and timers within the capsule, etc. The output power of these transmitters is 500 watts (nominal). Automatic devices are provided to sense failure of modulation or output power in either the regular or a spare transmitter. Failure of the regular system components causes an automatic switchover to the spare equipment, with attendant alarms.

In addition to the failure sensing devices provided for the command system, verification of successful transmission of commands to the capsule can be obtained by observing that corresponding changes have occurred in the telemetry information received at the site.

An emergency communications feature is available at sites equipped with command radio transmitters. Either of the two transmitters (which are frequency modulated) can be voice modulated for voice transmission to the capsule. The Astronaut can respond by keying the telemetry transmitter in the same manner that a radio message is transmitted by code or interrupted continuous wave.

6.3 EQUIPMENT ALLOCATIONS

Table 6-1 lists the major equipments at the sites.

6.4 EQUIPMENT LOCATIONS

Equipment locations are specified on the site drawing. A list of these drawings follows:

Figures 6-18,-19,-20,-27 — Grand Canary Island
Figures 6-22,-23,-23 — Muchea
Figures 6-25,-26,-27 — Woomera
Figures 6-20,-24,-29,-30 — Guaymas
Figures 6-20,-27,-32,-33 — Corpus Christi

TABLE 6-1
EQUIPMENT ALLOCATIONS — GRAND CANARY ISLAND; MUCHEA, AUSTRALIA; WOOMERA, AUSTRALIA; GUAYMAS, MEXICO; CORPUS CHRISTI, TEXAS

System	*Equipment*	*Type or Model*	*Supplied By*
Acquisition	Active Acquisition Aid (2)		Conoga Cubic
	Acquisition Data Console (2)		Bendix Radio
	Synchro Remoting System		Milgo
	Synchro Line Amplifiers		
Radar Tracking	S-band (See Note 1)	Verlort	Reeves
	C-band (See Note 2)	FPS-16	RCA
Data Processing System	Radar to Teletype Converter	165	Milgo
	A/D—D/A Converters (See Note 3)	4005T and 4005R	Milgo
	Polar/Cartesian Coordinate Converter	4003	Milgo
	Plotboard	3010	Milgo
Telemetry	Preamplifiers	PR-203	Nems-Clarke
	Receiver	1434	Nems-Clarke
	Receiver	1412	Nems-Clarke
	Diversity Combiner	DCA 500	Nems-Clarke
	Decommutators 90/90	TDS-90	Arnoux
	Discriminators	TDA-102	Bendix
	Tape Recorder	FR-114	Ampex
	Decommutators 90/15 (See Note 4)	TDS-90	Arnoux
Displays	Capsule Communicator Console		Bendix
	Aeromedical Observer Console		Bendix
	Capsule Observer Console		Bendix
Capsule Command Transmitting System (See Note 4)	Transmitter	AN/FRW-2	Collins-Alpha
	Audio Coder	KY-171/URW	Collins-Alpha
	Coder Controller	C-1669/URW	Collins-Alpha
Capsule Communications	HF Transmitter	CS-2029	Gates
	HF Trans-Remote Control	M5167	Gates
	HF Receiver	390A/URR	Collins
	UHF Transmitter, consisting of:	AN/GRT-3	Radio Receptor
	UHF Transmitter	T282/GR	Radio Receptor
	Modulator-PWR Supply	MD-141A/GR	Radio Receptor
	UHF Receiver	R278B/GR	Collins
	Power Modulation Monitor	SG41.1 and SG 41.2	McJones
	Tape Recorder	728	Magnacord
	Sidetone Line Amplifier	LA200	Bendix Radio
Timing	Time Standard Rack Assembly		Bendix Radio

Notes: 1. Located at Grand Canary Island, Muchea, Guaymas, and Corpus Christi.
2. Located at Woomera only.
3. Located at Grand Canary Island only.
4. Located at Muchea and Guaymas only.

6.5 SITE ADMINISTRATION

See Figure 6-34.

6.6 GEOGRAPHIC AND CLIMATIC DATA

6.6.1 Grand Canary Island

The Canary Islands, volcanic in origin, are a semiarid to arid (desert) area. Grand Canary Island is approximately circular in shape, with a diameter of 28 to 30 miles. A volcanic cone rises to a height of 6,000 feet in the central area. Deposits from past activity of this defunct cone have created coastal lowlands up to two kilometers (1¼ miles) in width. The Mercury site is located near the sea on one of these lowlands, as shown in Figure 6-17.

The site is 20 feet above sea level and 40 miles from Las Palmas, the capital and largest city on the island. Site coordinates are latitude 27°45′ N, longitude 15°36′ W.

Grand Canary Island has an arid climate, and fair weather predominates. Average rainfall is 5 to 7 inches.

Prevailing winds are NNW. Average temperatures are 73°F in summer and 67°F in winter. High and low temperatures and average humidity are as follows:

	Maximum	*Minimum*	*Average Humidity*
Summer	83°	65°	75%
Winter	75°	58°	68%

No hurricanes or typhoons have been experienced in this area.

6.6.2 Muchea, Australia

The general location of the Mercury site is shown on Figure 6-21. The site is near the town of Muchea, which is approximately 17 miles northeast of Perth, as shown in Figure 6-19. The site coordinates are latitude 30° S, longitude 135° W.

The climate is moderate and is similar to that of southern California. Seasons are reversed from those of the United States with summer occurring from mid-December to mid-March.

Temperature extremes and averages are:

	Extremes	*Average*
Summer	85.1°	73.5°
Winter	47.8°	55.5°

The average annual rainfall is approximately 35 inches, the most falling from May to September.

6.6.3 Woomera, Australia

The general location of the Mercury site is shown on Figure 6-21. The site is located on the Australian Research Establishment range, and is near the town of Woomera, which is 300 miles north of the city of Adelaide. Site coordinates are latitude 31°12′ S, longitude 137°06′ E.

The climate is moderate and is very similar to that found in the Muchea area. Average temperatures are: summer 72.9°F, winter 53.3°F. Seasons are reversed from those of the Northern Hemisphere, with summer occurring from mid-December to mid-March. The average annual rainfall is approximately 21 inches. The area humidity is relatively low.

6.6.4 Guaymas, Mexico

Guaymas is located 270 miles south of Nogales, Arizona, (Figure 6-28) on the eastern coast of the Gulf of California. Guaymas, Mexico, is a fishing and resort center, with a population of approximately 18,000. Site coordinates are latitude 28.00° N, longitude 110.83° E.

Temperatures range from a summer high of 107°F to a winter low of 41.3°F. Based on official records for a five-year period, the hottest months are July, August, and September with average temperatures of 87°F, and a rainfall of 1.8, 3.0, and 2.1 inches, respectively, for these months. December through March have average temperatures in the upper 60's. The rate of precipitation during this period exceeds one inch only in December. Maximum rainfall recorded for a 24-hour period during the past ten years was 4.6 inches.

Heavy storms are rare and no hurricanes have been recorded in the past ten years. Prevailing winds are from the southwest and are gentle.

6.6.5 Corpus Christi, Texas

The Mercury site is located at Rodd Field, a deactivated airfield, formerly an auxiliary training base for the Naval Air Station at Corpus Christi (Figure 6-31).

The site is in southern Texas near Route 357, and is approximately seven air miles southwest of the United States Naval Air Station. Site coordinates are latitude 27.67° N, longitude 97.33° W.

The climate is classified as intermediate between the conditions of the humid subtropical area to the northeast and the semiarid area to the west. The average annual precipitation is about 26 inches, with the heaviest rainfall during May and June, and during September and October. High and low temperatures, and relative humidity figures are:

	Temperature		*Relative Humidity*	
	High	*Low*	*High*	*Low*
Summer	86.5°	78.5°	68%	58%
Winter	63.1°	53.1°	75%	63%

6.7 TRANSPORTATION AND COMMUNICATIONS

6.7.1 Grand Canary Island

Transportation by automobile from Las Palmas to the site takes approximately 1½ hours. The road from Las Palmas is level and is paved, except for the last five miles. A bus line makes two round trips to the site area daily. Taxis and tourist cars are available at reasonable rates.

Local communications facilities are good. The telephone facilities are provided by Compañía Telefónica National de España with general offices in Las Palmas. Telephone and telegraph services are available to the continental United States.

Air transportation to Las Palmas and Tenerife (a nearby island) originates from Madrid and Seville, Spain. There are several flights each week, and the nonstop flying time is 5 hours. Daily interisland flights are available between Las Palmas and Tenerife.

Steamship service to the island is currently on a semiweekly basis, with service between Grand Canary Island and Barcelona or Cadiz, Spain. Steamship travel time is approximately 3½ days.

6.7.2 Muchea, Australia

Bus transportation is available from the Mercury site to the city of Perth. The Department of Supply (Australian) augments this service with other transportation when the site is operational.

Fast modern aircraft link all state capitals (Perth is the capital of Western Australia), and many other locations. Several airlines operate between Australia and the United States, including Pan American Airways, British Overseas Airlines, and Qantas Empire Airways (the Australian government's overseas airline). The Qantas Airline operates two-way jet service around the world and through the United States, making possible direct flights, routed either New York-San Francisco-Sydney, Australia, or New York-London-Sydney, Australia. Pan American Airways operates a Los Angeles-Sydney route.

Intra-Australia transportation is also provided by a 27,000-mile, state-government-owned railway network, which offers efficient, speedy, and reasonably priced train service. Fair to good roads link most of the settled areas.

Two shipping companies, the Orient Line and the Matson Line, have regular passenger sailings from San Francisco to Australia.

The local communication facilities are good, and are under the control of the British Post Office.

6.7.3 Woomera, Australia

Local transportation is provided by the Australian authorities.

For information concerning other modes of transportation and communication refer to the previous paragraph 6.7.2 on Muchea, Australia.

6.7.4 Guaymas, Mexico

Air service to Guaymas is provided every other day. The landing strip at Guaymas is unpaved and accommodates daylight service only. The DC-3 aircraft servicing Guaymas carry some airfreight. They are operated by Aeronaves de Mexico. Night and day service is avail-

able at Hermasillo, however, which has a paved and lighted landing strip accommodating DC-7 aircraft. Taxis can be hired from Hermasillo to Guaymas, a distance of 70 miles.

Rail service to Guaymas is provided by one train north and one train south each day. A spur track, located at Empalme, is approximately 10 kilometers (6.25 miles) from the Mercury site.

Trucking is recommended inasmuch as the Mercury site is 14 kilometers (8.7 miles) east of Guaymas, and this mode of transportation eliminates the problem of reshipping supplies from the rail terminal to the site.

Rental automobiles are available with or without drivers. Costs are variable, depending upon local arrangements made at the time of rental. Inasmuch as the site is 20 kilometers (12.5 miles) to the recommended housing at Miramar Beach, the resort section of Guaymas, personnel assigned to this site should consider use of their personal cars, but under the following considerations.

Private cars must be bonded prior to Mexican entry inasmuch as U.S. insurance, with few exceptions, does not provide adequate or recognized coverage. The U.S. Consulate can provide a list of reputable insurance brokers at the various ports of entry. Car permits valid for 90 days, must be obtained from Mexican Customs at the port of entry. Failure to renew a permit results in a fine three times the amount of the normal customs duty, which is usually the value of the car. Proof of ownership of the vehicle must be shown entering and leaving Mexico. In addition, a notarized affidavit authorizing use of the vehicle in Mexico must accompany a vehicle not owned by the operator. Tourist cards are noted "with car", and the tourist may not leave the country without the vehicle unless special arrangements are made with the Mexican Custom officials. In this case a bond costing approximately $13.00 (160 pesos) must be paid to the custom officials. Lapsed auto registration must be renewed with the state issuing the lapsed registration. The new registration license and plates can be forwarded to U.S. Border Customs for reclaiming upon reentry into the United States.

Bus service is available from Miramar to Guaymas, and is a typical rural Mexican service. It is not recommended for transportation to the site. The local taxicab company rents cars by the day, week, or month for this purpose. A General Motors dealer and service station are located in Guaymas.

Cable, wire, and telephone service are available in Guaymas.

6.7.5 Corpus Christi, Texas

There are three airports in or near the city of Corpus Christi. Braniff, Eastern Air Lines, and Trans-Texas provide service in the area.

Three raliroads, the Missouri Pacific, the Southern Pacific (freight only), and the Texas-Mexican (freight only), provide rail service to the area.

Continental Trailways, Union Trailways, and Greyhound provide intercity bus service.

Intracity transportation is provided by a local bus line and by taxi service. The Southwestern Bell Telephone Company provides telephone service.

6.8 SITE PERSONNEL FACILITIES AND SERVICES

6.8.1 Grand Canary Island

Site personnel live in offsite housing available in Las Palmas, a city of approximately 200,000 population. Hotel accommodations are available at $4.00 to $7.00 per day. Three-room furnished apartments are available at approximately $150.00 to $200.00 per month. There are many furnished houses and villas for rent along the coast.

Medical and dental facilities are adequate, with English-speaking doctors in Las Palmas. Drugs and medical supplies are available in ample quantities. A new hospital is under construction at this writing, in addition to hospitals already in service in the city.

Recreational facilities available include boating, fishing, golf, and swimming. Spectator sports include football, greyhound racing, boxing, and basque ball.

Airmail service to the United States is fair, with approximately five days required for delivery.

Catholic services (in Spanish) are conducted in all large towns. There are no Protestant services held in Las Palmas.

Special clothing is not required for the area. Clothing selections should be made based on the climatic data supplied for this site. Hats are recommended because of the hot sun. A wide selection of clothing is available, at prices somewhat lower than those charged in the New York area.

Fruits, vegetables, and fish are plentiful and are relatively cheap. Good meats are not obtainable. Bottled water is commonly used and is available in Las Palmas and other city areas most of the year. There is presently a good supply of English canned foods, and the situation is expected to improve in the future as local firms are preparing to import English and American foods in greater quantities.

6.8.2 Muchea, Australia

Site personnel live in offsite housing in Perth, the capital and largest city of Western Australia. There are over twenty hotels in the city with average rates from $4.00 to $7.00 per day. Two-room furnished apartments rent for approximately $17.00 per week.

There are adequate medical and dental facilities in Perth. The Royal Perth Hospital is a modern hospital and is currently undergoing modifications and expansion.

Recreational facilities are abundant, including fishing, swimming, boating, golf, tennis, movies, etc.

Airmail service to the United States requires approximately four days. Regular mail (via ship) requires approximately thirty days.

Major religious denominations holding services in Perth are Anglican, Roman Catholic, Presbyterian, Lutheran, Christian Science, Seventh Day Adventist, Baptist, and Jewish.

No special clothing is required. There is a good selection of clothing available, with prices approximately the same as in the United States. The same variety of meats, vegetables, and groceries found in the United States are supplied in Australia. Prices of pork and poultry are slightly higher than U.S.A. prices, but beef and mutton are lower priced. Vegetable and grocery prices are also slightly lower than those of the United States.

The electrical power supply in Perth and throughout Western Australia is 250/440-volt, 40-cycle, 3-phase alternating current (AC). For this reason, many U.S. appliances, including radios, will not work in the area. License fees are charged for using personally owned radios and television sets, with the revenue applied to the government broadcasting services for programs without commercials. The fee for radio sets is $6.20 per year, and for television receivers, $11.25 per year.

6.8.3 Woomera, Australia

No commercial hotels or motels are available in this area, which adds to a housing problem at the site. Small housing units, apartments, and single quarters are available at Woomera Village, but are assigned by the authorities on an "as needed" basis. The cost of a single quarters is approximately $1.50 per night. Because of the housing difficulties outlined above, it is recommended that no attempt be made to bring a family to this area.

There is a hospital at the site, with doctors in attendance.

Recreational facilities are somewhat limited, but a movie theater and swimming pool are provided.

Religious services for Anglican, Protestant, and Roman Catholic denominations are held in Woomera. Other denominations hold religious services in Adelaide, a city some 300 miles to the south.

Electrical power in this area is 240-volt, 50-cycle AC, so many appliances of U.S. manufacture will not work.

For information concerning clothing and food costs, refer to paragraph 6.8.2.

6.8.4 Guaymas, Mexico

Private home rentals are not recommended, due to the lack of conveniences considered essential in the U.S. home and the problems encountered with local food and the city water supply. A number of hotels and motels are listed for the convenience of site personnel, with rates where known.

a. *Hotel Miramar*—Owned by the Mayor of Guaymas, air-conditioned, and with restaurant facilities. Rates are $4.80 per day, excluding meals. Reduction in rates are granted for extended rentals. This hotel overlooks Miramar Beach. The average daily cost for food is 100 pesos ($8.50).

b. *Hotel Plava de Cortes*—Air-conditioned with swinmming pool and dining room. The daily rate including meals for one person is 186 pesos ($15.00).

c. *Guaymas Inn*—Located 3½ miles north of Guaymas on Route 15. It is air-conditioned, and has swimming pool, showers, and dining room. Single rates excluding meals are 60 pesos per day ($4.80).

d. *Hotel Casa Grande*—No rates available.

e. *Motel Flamingo*—No rates available.

f. *Motel Armida*—No rates available.

NOTE

All rates above are current at this writing, but are subject to change and should be verified. Little American food is available although Mexican food and sea food are in plentiful supply. Canned goods, cigarettes, beverages, and spirits of all types are available.

A hospital in Guaymas has doctors available. Modern drugs are available in local pharmacies. Special precautions to be observed include drinking only bottled water (avoiding the treated city water which is chlorinated, but risky), a gradual acclimation to the highly spiced local foods, light clothing and summer hats for protection against the high heat and bright sun. Diarrhea and amoebic dysentery are present, but medical countermeasures are available. Fresh vegetables should be well cooked and care should be used with ice, as in mixed drinks. There are no sanitary sewers outside the central part of the city.

Guaymas offers the typical recreations to be found in a Mexican tourist and fishing resort, including fishing, swimming, boating, and movies. Dances are also held at some of the local hotels. There are no television programs in the area. Electrical power supply is 115-volts, 60-cycle AC. U.S. appliances, such as shavers and radios, function normally.

Three days are required for airmail service to Los Angeles, four days are required to Detroit. Airmail must be at the Guaymas post office before noon to be dispatched on that day, regular mail (by train) before 7 P.M.

NOTE

Guaymas is two hours behind New York in time zones.

Roman Catholic and Seventh Day Adventist churches are found in Guaymas.

Clothing should be selected in accordance with the temperature extremes listed paragraph 6.6.4. All types of clothing are available locally at low prices, including shoes. There is a large dry goods store in the city of Guaymas, similar to Sears and Roebuck.

6.8.5 Corpus Christi, Texas

Housing is readily available in the area with numerous hotels, motels, apartments, and homes for rent.

Hotel and motel rates vary upward from $4.00 per night single. There are upwards of seven trailer parks with rates starting from $18.00 per month.

Rental apartments are mostly furnished. The lowest rentals start at $40.00 per month, but it is difficult to find desirable quarters in this price range.

A small number of houses are for rent in the area, with minimum rentals at $45.00 per month and up, depending upon size and condition. Houses for sale are plentiful, and range in price from $7,000.00 and up.

6.8.4 Guaymas, Mexico

Private home rentals are not recommended, due to the lack of conveniences considered essential in the U.S. home and the problems encountered with local food and the city water supply. A number of hotels and motels are listed for the convenience of site personnel, with rates where known.

a. *Hotel Miramar*—Owned by the Mayor of Guaymas, air-conditioned, and with restaurant facilities. Rates are $4.80 per day, excluding meals. Reduction in rates are granted for extended rentals. This hotel overlooks Miramar Beach. The average daily cost for food is 100 pesos ($8.50).

b. *Hotel Plava de Cortes*—Air-conditioned with swinmming pool and dining room. The daily rate including meals for one person is 186 pesos ($15.00).

c. *Guaymas Inn*—Located 3½ miles north of Guaymas on Route 15. It is air-conditioned, and has swimming pool, showers, and dining room. Single rates excluding meals are 60 pesos per day ($4.80).

d. *Hotel Casa Grande*—No rates available.

e. *Motel Flamingo*—No rates available.

f. *Motel Armida*—No rates available.

NOTE

All rates above are current at this writing, but are subject to change and should be verified. Little American food is available although Mexican food and sea food are in plentiful supply. Canned goods, cigarettes, beverages, and spirits of all types are available.

A hospital in Guaymas has doctors available. Modern drugs are available in local pharmacies. Special precautions to be observed include drinking only bottled water (avoiding the treated city water which is chlorinated, but risky), a gradual acclimation to the highly spiced local foods, light clothing and summer hats for protection against the high heat and bright sun. Diarrhea and amoebic dysentery are present, but medical countermeasures are available. Fresh vegetables should be well cooked and care should be used with ice, as in mixed drinks. There are no sanitary sewers outside the central part of the city.

Guaymas offers the typical recreations to be found in a Mexican tourist and fishing resort, including fishing, swimming, boating, and movies. Dances are also held at some of the local hotels. There are no television programs in the area. Electrical power supply is 115-volts, 60-cycle AC. U.S. appliances, such as shavers and radios, function normally.

Three days are required for airmail service to Los Angeles, four days are required to Detroit. Airmail must be at the Guaymas post office before noon to be dispatched on that day, regular mail (by train) before 7 P.M.

NOTE

Guaymas is two hours behind New York in time zones.

Roman Catholic and Seventh Day Adventist churches are found in Guaymas.

Clothing should be selected in accordance with the temperature extremes listed paragraph 6.6.4. All types of clothing are available locally at low prices, including shoes. There is a large dry goods store in the city of Guaymas, similar to Sears and Roebuck.

6.8.5 Corpus Christi, Texas

Housing is readily available in the area with numerous hotels, motels, apartments, and homes for rent.

Hotel and motel rates vary upward from $4.00 per night single. There are upwards of seven trailer parks with rates starting from $18.00 per month.

Rental apartments are mostly furnished. The lowest rentals start at $40.00 per month, but it is difficult to find desirable quarters in this price range.

A small number of houses are for rent in the area, with minimum rentals at $45.00 per month and up, depending upon size and condition. Houses for sale are plentiful, and range in price from $7,000.00 and up.

b. A tourist card (if the visitor is over 15 years old), obtained from any Mexican consul or from the Mexican Immigration Office at the point of entry. Two types of cards are issued, each of which is valid for 180 days: a single entry card, costing approximately $3.00, and a multiple entry card, costing approximately $5.00. Two front-view passport size photographs are required when the latter card is used. Minors under 15 years of age are included in their parents' tourist card.

NOTE

Any person on a business trip who is travelling on a tourist card is subject to fines. Business trips should be cleared through the consulate before departure.

Certain immunizations, indicated in Table 1-3, are recommended for visitors to Mexico. Antityphoid injections are also recommended. Some water supplies are known to contain cholera germs, indicating desirability of an anticholera injection.

Tax requirements for Mercury personnel are not clearly defined at this writing. It is anticipated that the Mexican tax structure will create no additional problems for personnel assigned here, because of deductions allowed by the Federal Government for taxes paid to a foreign country.

Customs requirements are listed for entering and leaving Mexico.

a. *Entering Mexico*—Baggage is examined by Mexican customs at the border. It is then sealed to avoid additional inspections at various substations farther south on the highway. Visitors may take up to 100 pounds into Mexico duty free. Each visitor may bring in one camera and a portable motion picture camera, with 12 rolls of film for each. One firearm and up to 50 cartridges may also be brought in, but the procedure is complicated and can cause delays. A permit for the firearm must first be obtained from the Mexican consul, who requires a character reference from the visitor's local police chief or sheriff, followed by approval of the permit by the General of the (Mexican) Army division at the point of entry. The latter may delay the tourist considerably, particularly on weekends. Sports and camping equipment, portable radio and television sets are allowed. A tourist may bring in three bottles of alcoholic beverages, and either two cartons of cigarettes or a box of 50 cigars. (Raleigh cigarettes are manufactured in Mexico.)

b. *Entering the U.S.*—Articles not exceeding $200.00 in value may be brought back duty free if your visit in Mexico is for less than 12 days. An additional exemption of $300.00 is granted for stays of more than 12 days, not including, however, liquor, wines, and cigars. Citizens may bring back 1 gallon of spirits duty free, depending upon the laws in the state of their permanent or legal residence. It is recommended that a Declaration of Purchases form be executed in advance of arrival at the point of entry—this can be obtained prior to entering Mexico. It is wise to register articles that may be considered taxable upon your reentry into the U.S. with customs officials before leaving the country, to avoid possible payment of a duty on these items when returning to the U.S.

Gifts in packages, not exceeding $10.00, may be sent to the U.S. without declaration, U.S. Customs duty, or tax thereon.

Different units of measurement are used in Mexico. These are listed along with conversion factors to U.S. equivalents.

a. Distance—The unit of measurement is the kilometer.

1 kilometer = ⅝ (0.625) miles
1.60935 kilometers = 1 mile
Kilometers (km) × ⅝ = miles
Miles ÷ ⅝ = kilometers
Note: 1 meter = 39.37 inches.

b. Weight—The unit of measurement is the kilogram.

1 kilogram = 2.2 pounds (approximate)
Kilograms times 22/10 = pounds
Pounds times 10/22 = kilograms
Example: A scale reading 100 kilograms equates to 220 pounds.

Typical tire pressures:

Kilos	*Pounds*
10	22
10.9	24
11.8	26
12.7	28
13.6	30

c. Liquid Measure—The unit of measurement is the liter. Four liters are equal to 1.06 U.S. gallons.

6.9.5 Corpus, Christi, Texas

The tax structure is listed for convenience of those considering the purchase of a home in the area, inasmuch as there are no state sales taxes and no income taxes. The city tax is $1.73 per $100.00 of assessed valuation. Assessed valuation is usually 67.5 percent of fair market or sales price for real estate, and 75 percent of full value for personal property (business property only). The school district tax is $1.53 per $100.00 of assessed value based upon the same method of valuation outlined above.

There is also a county and state tax, which amounts to $1.72 per $100.00 of assessed valuation. In this case the valuation is computed on 30 percent of the full value for real estate and 30 percent of full value for personal property (business property only).

The City of Corpus Christi has a current population of 175,000.

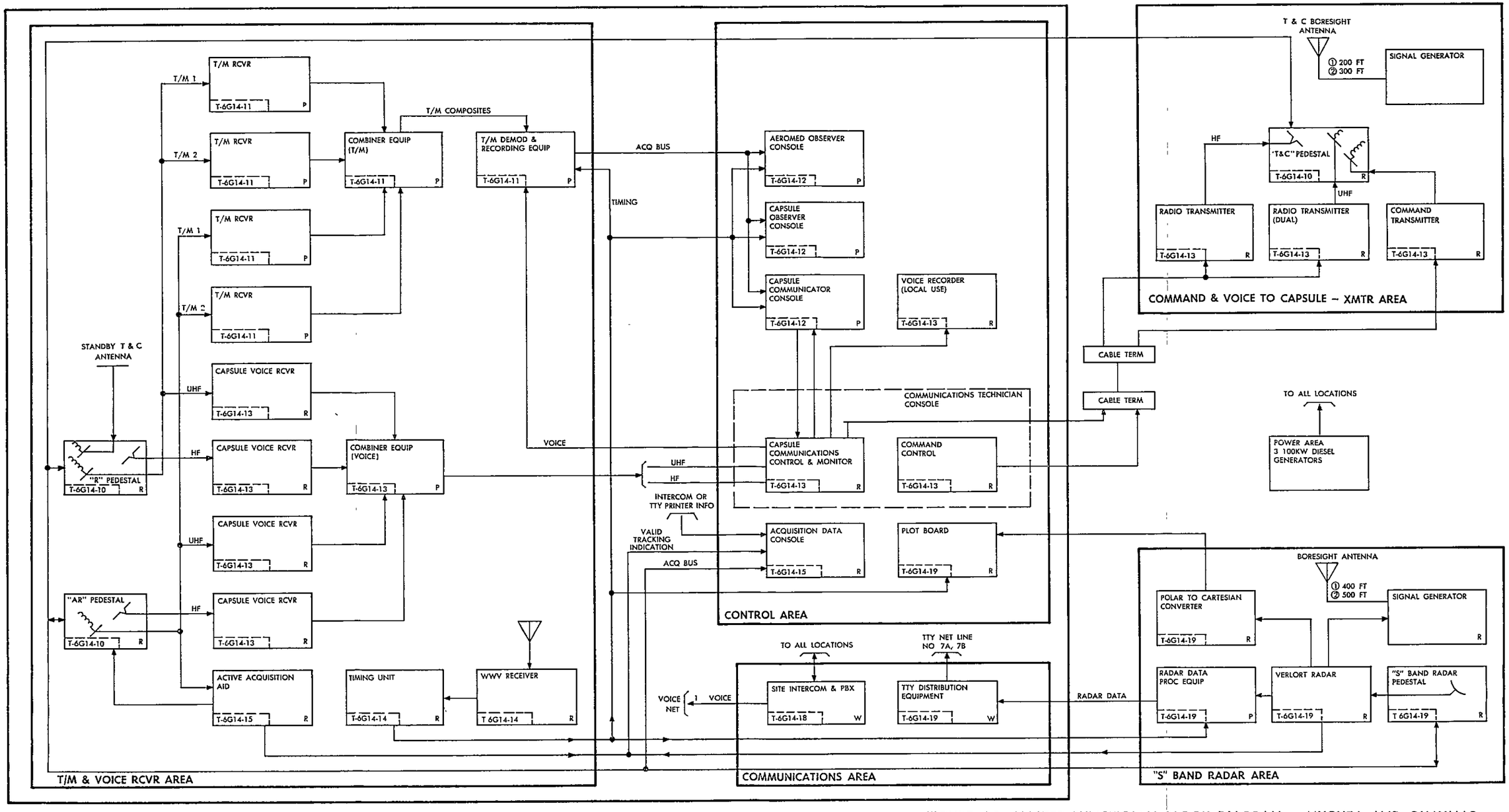


FIGURE 6-1. MASTER FUNCTIONAL BLOCK DIAGRAM — MUCHEA AND GUAYMAS

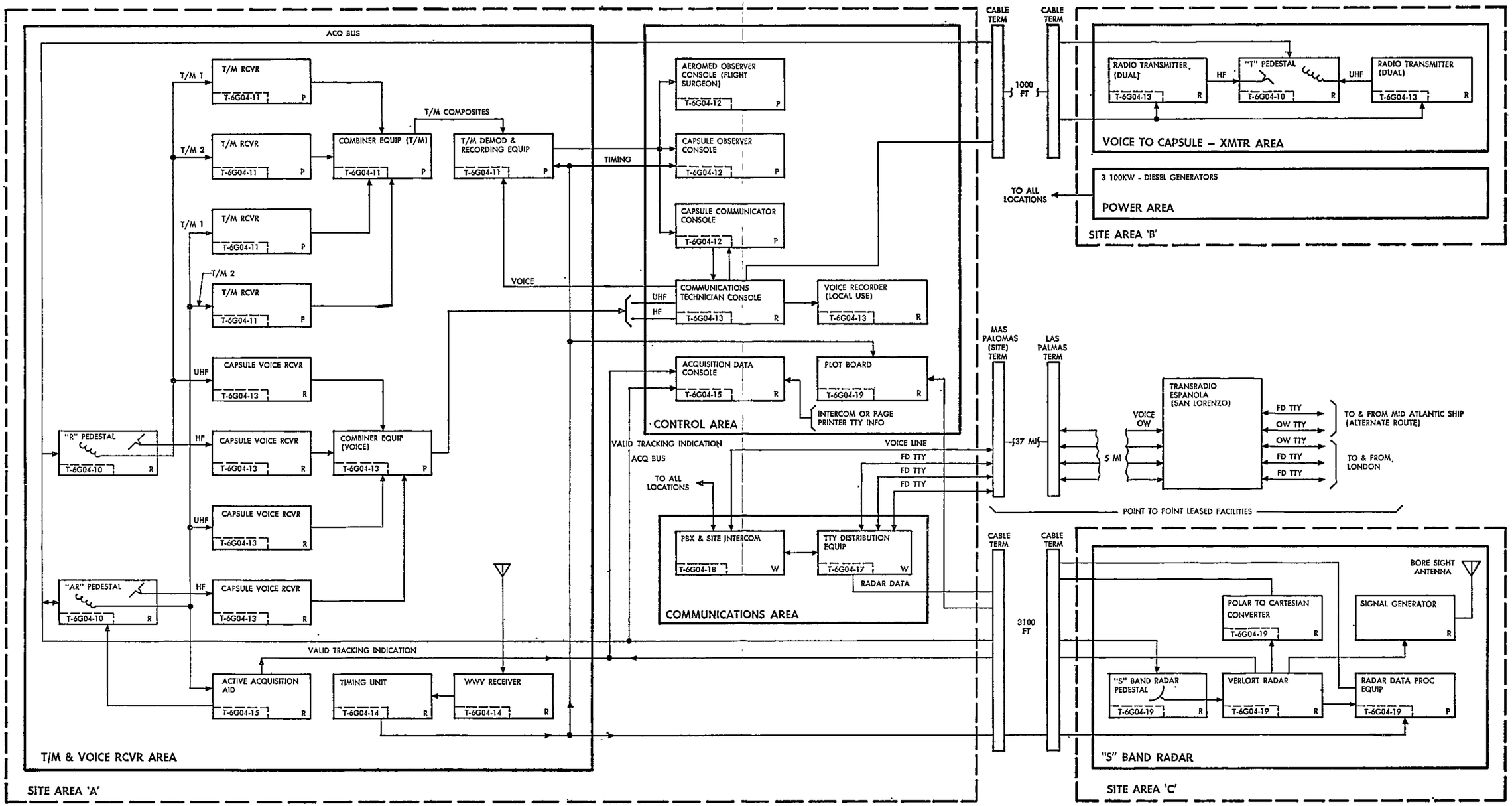


FIGURE 6-2. MASTER FUNCTIONAL BLOCK DIAGRAM — GRAND CANARY ISLAND

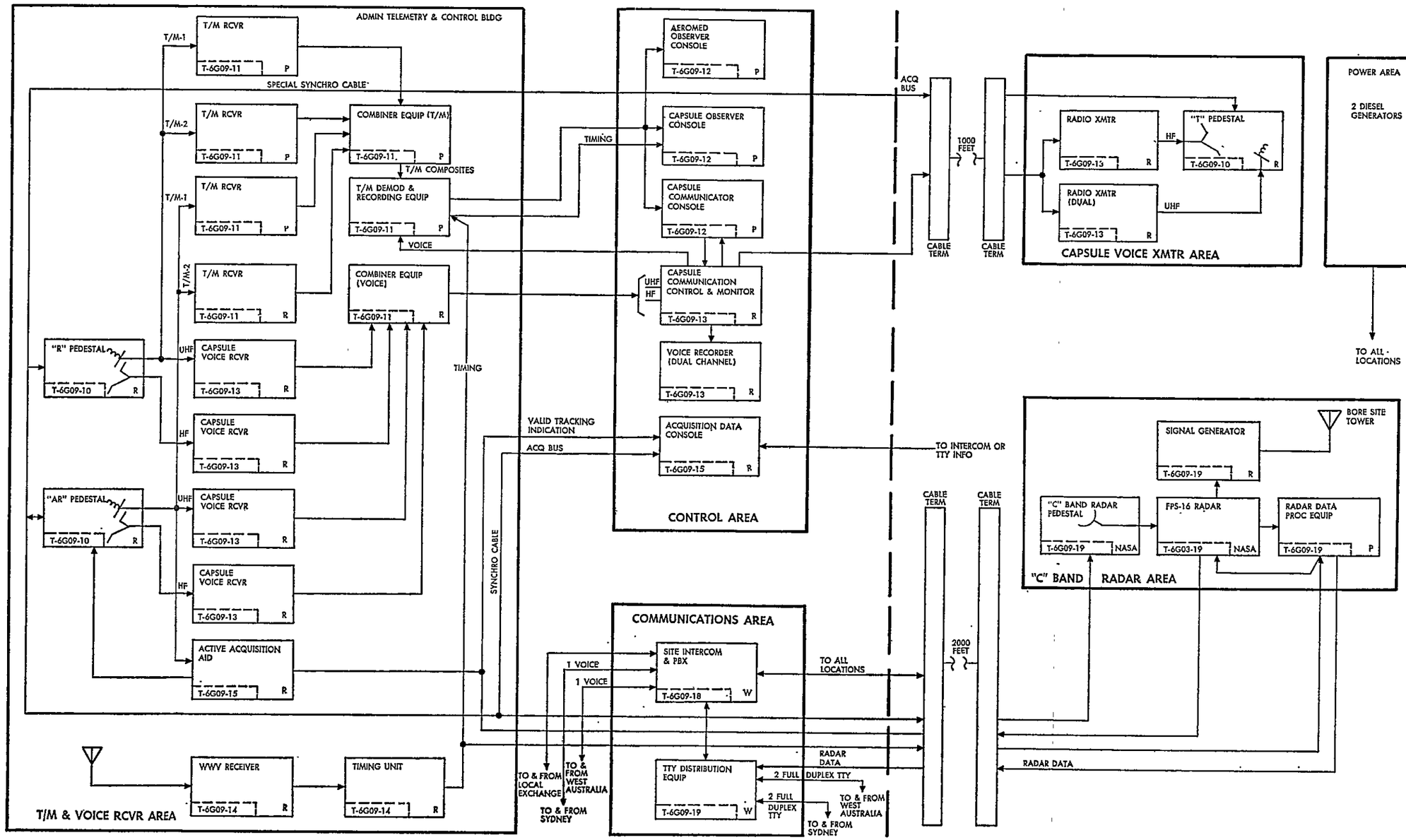


FIGURE 6-3. MASTER FUNCTIONAL BLOCK DIAGRAM — WOOMERA, AUSTRALIA

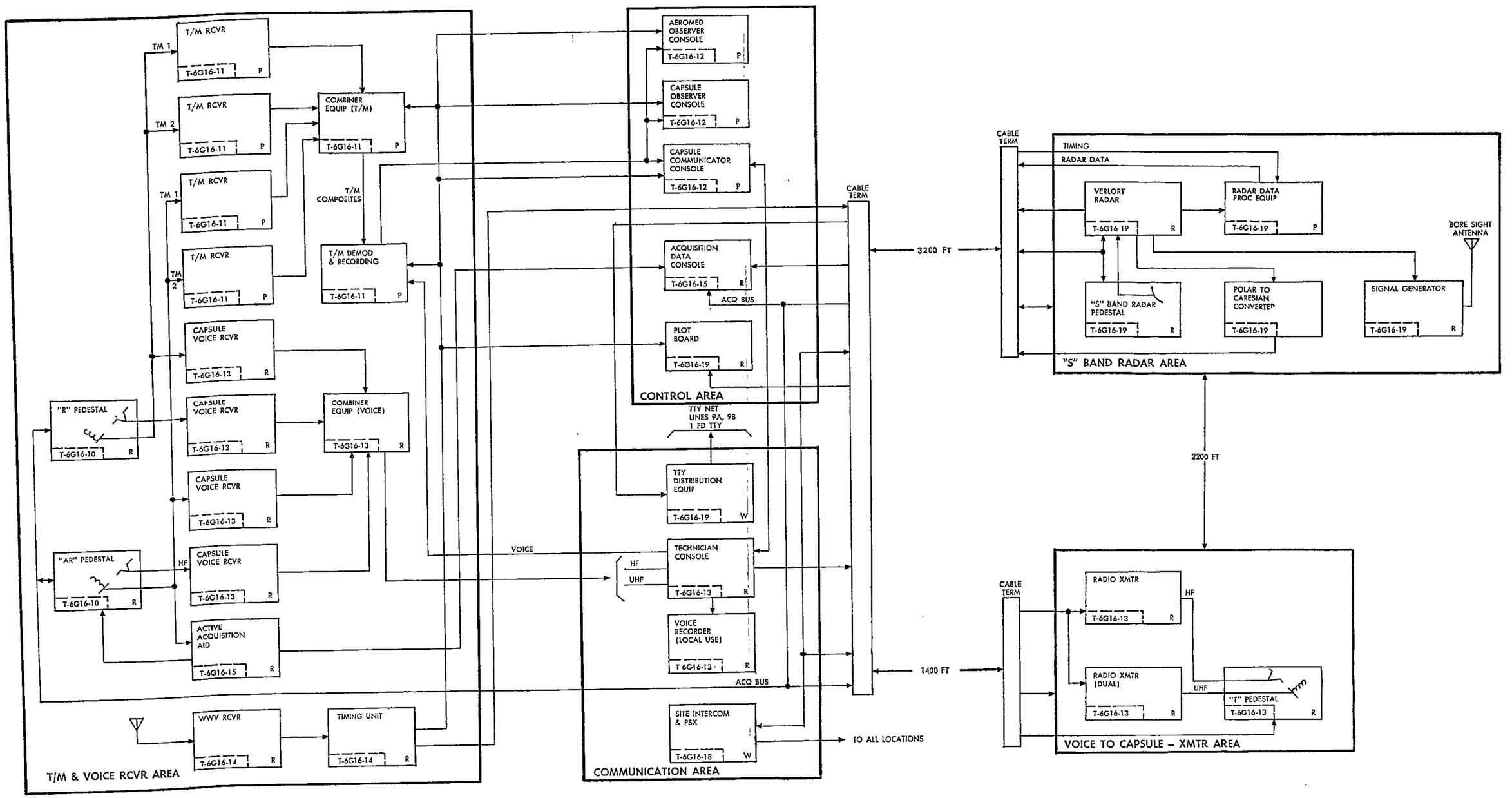


FIGURE 6-4. MASTER FUNCTIONAL BLOCK DIAGRAM — CORPUS CHRISTI, TEXAS

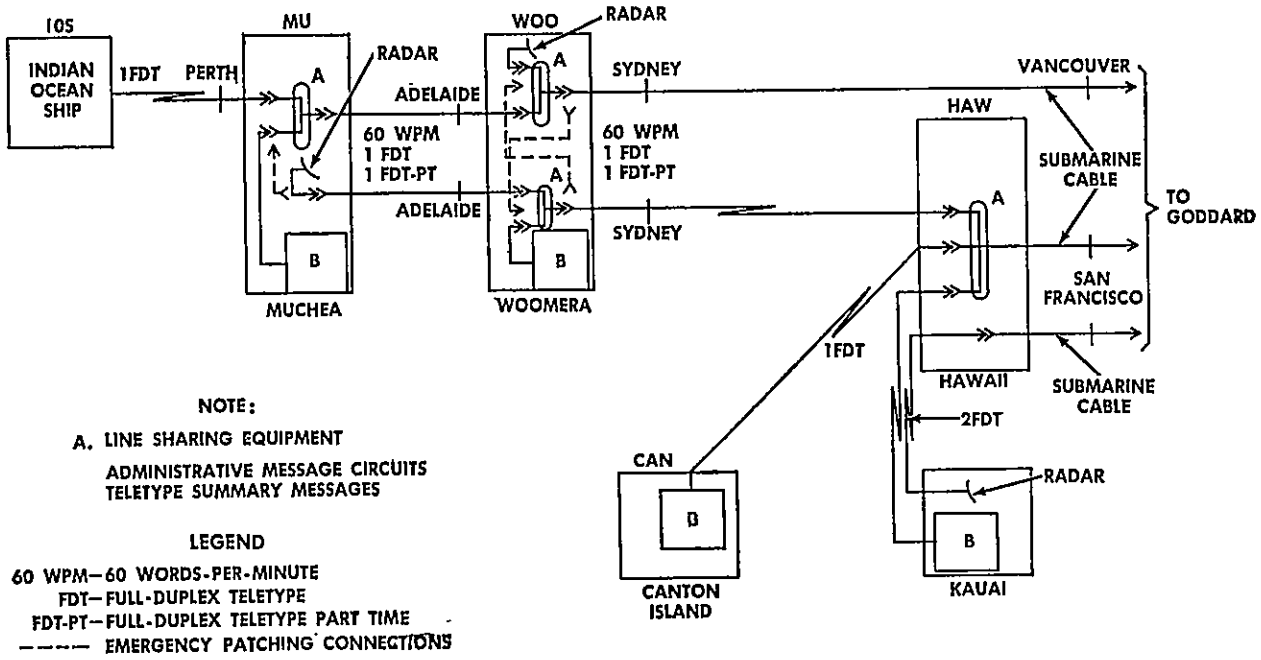


FIGURE 6-5. GROUND COMMUNICATIONS, TELETYPEWRITER LINE SHARING LAYOUT

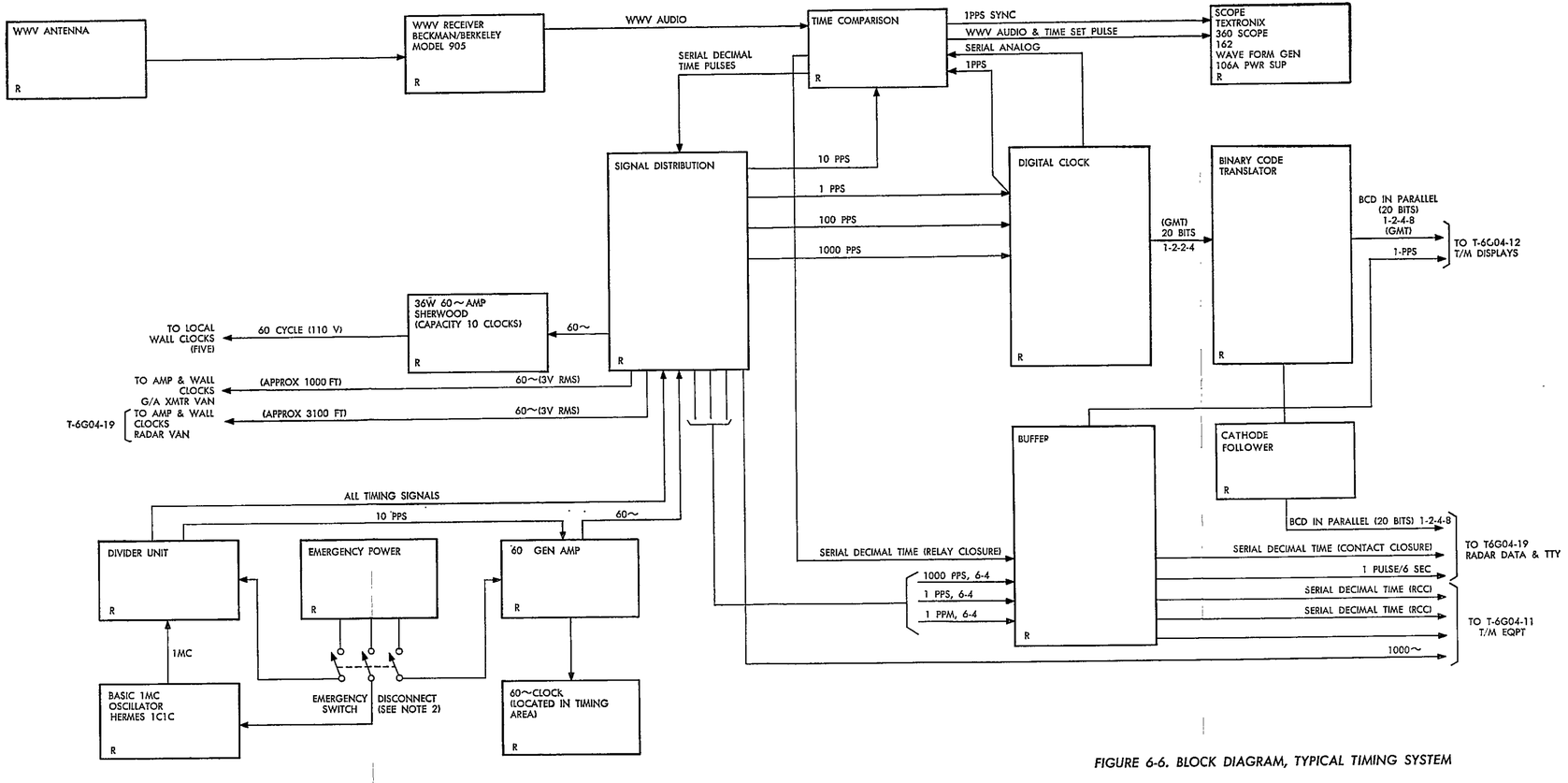


FIGURE 6-6. BLOCK DIAGRAM, TYPICAL TIMING SYSTEM

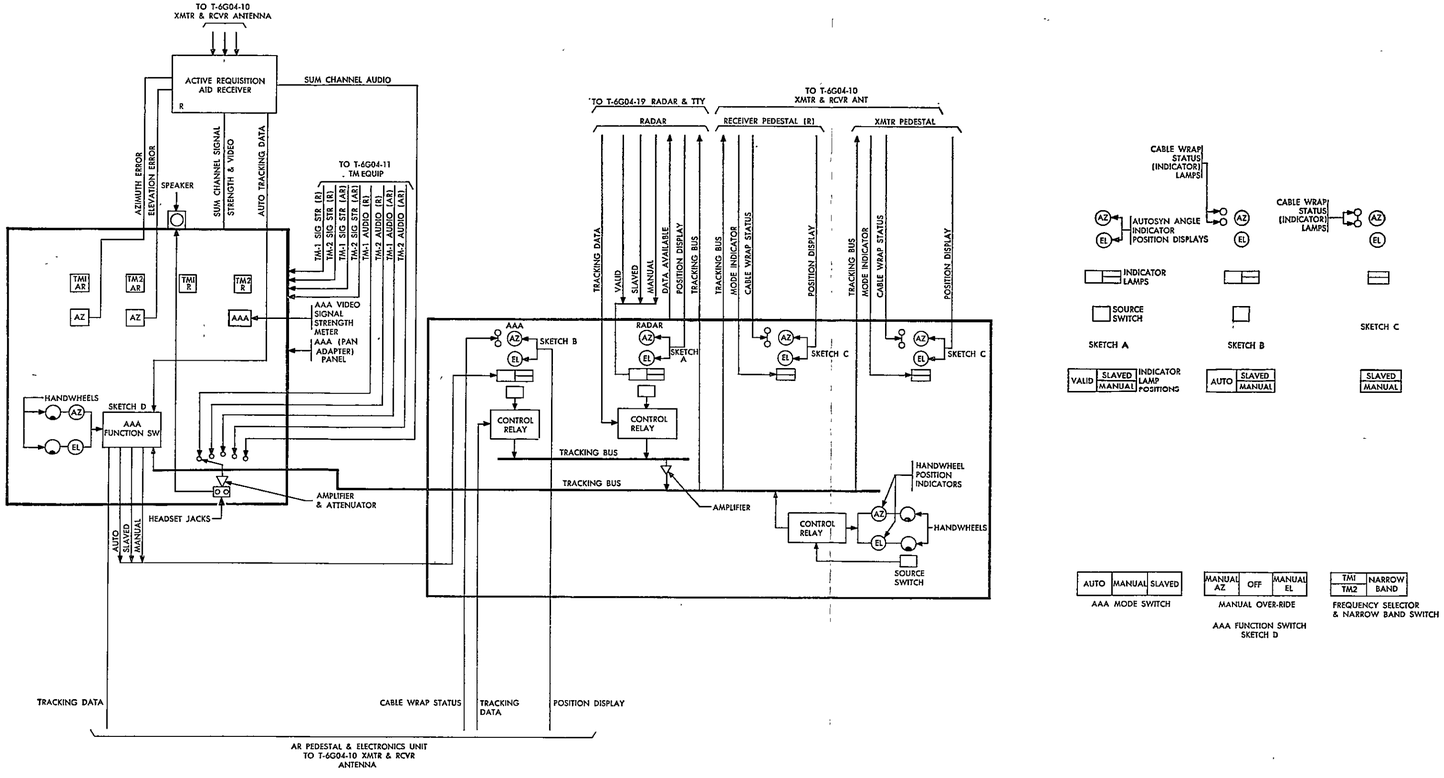


FIGURE 6-7. BLOCK DIAGRAM, ACQUISITION SYSTEM

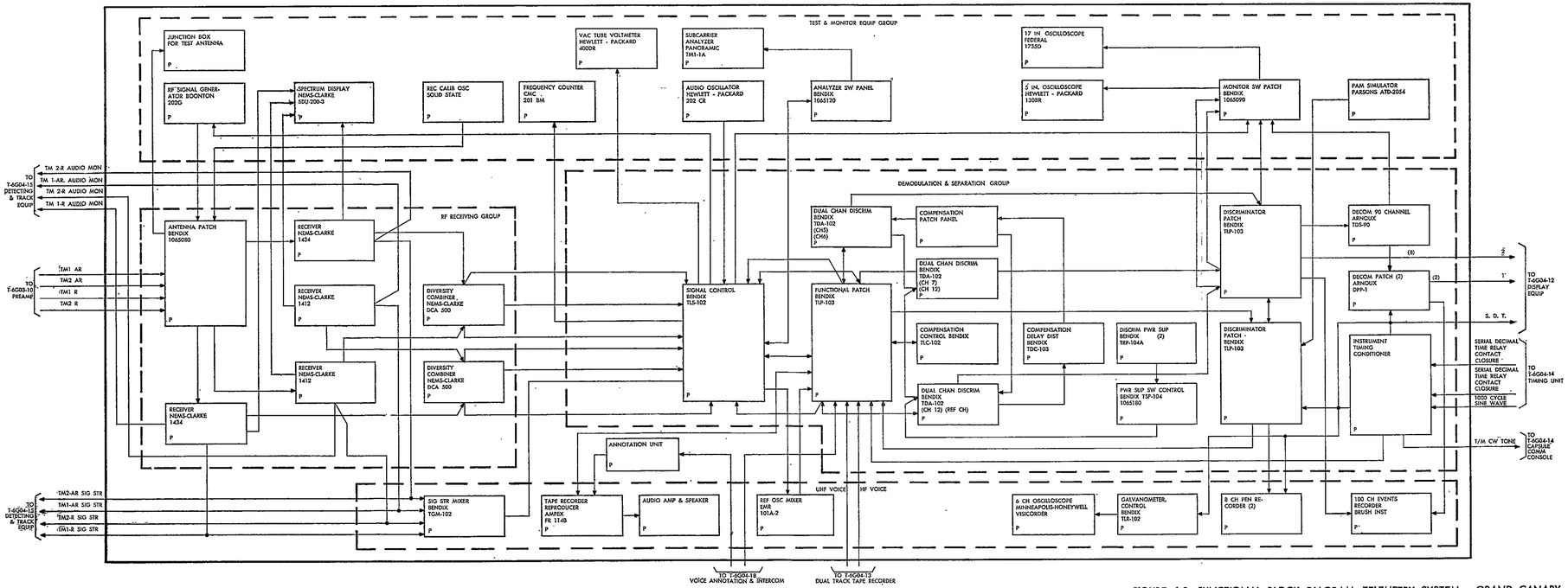


FIGURE 6-8. FUNCTIONAL BLOCK DIAGRAM, TELEMETRY SYSTEM — GRAND CANARY ISLAND, WOOMERA, AND CORPUS CHRISTI

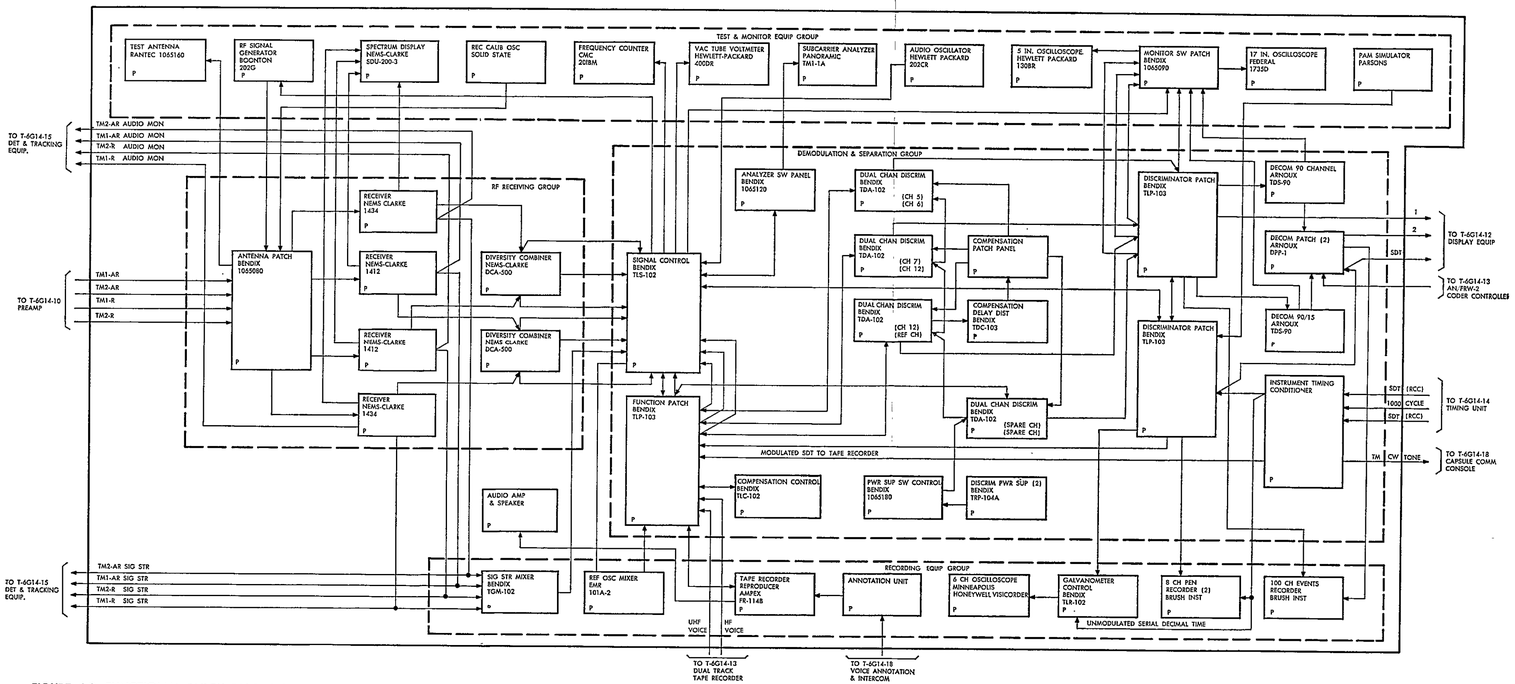


FIGURE 6-9. FUNCTIONAL BLOCK DIAGRAM, TELEMETRY SYSTEM — MUCHEA AND GUAYMAS

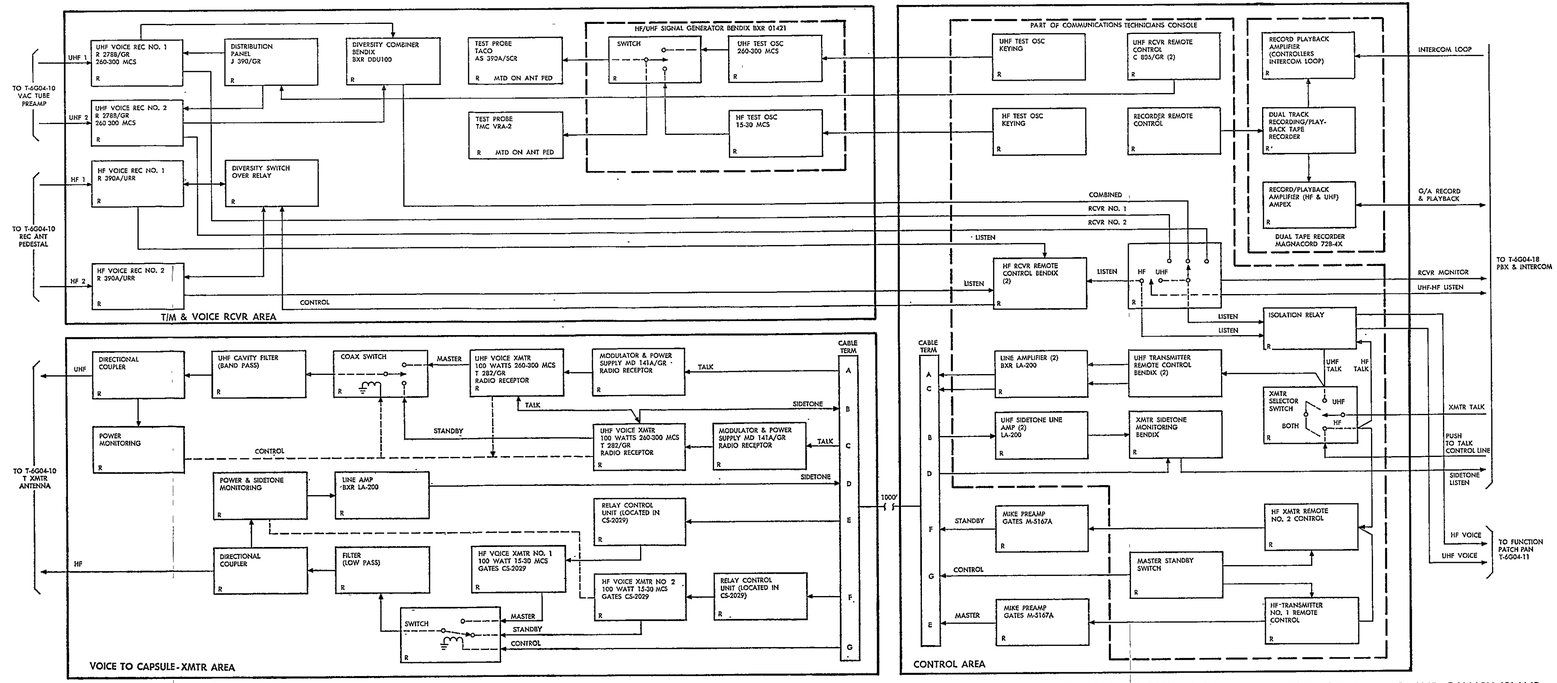


FIGURE 6-10. AIR-GROUND COMMUNICATIONS FACILITIES — GRAND CANARY ISLAND

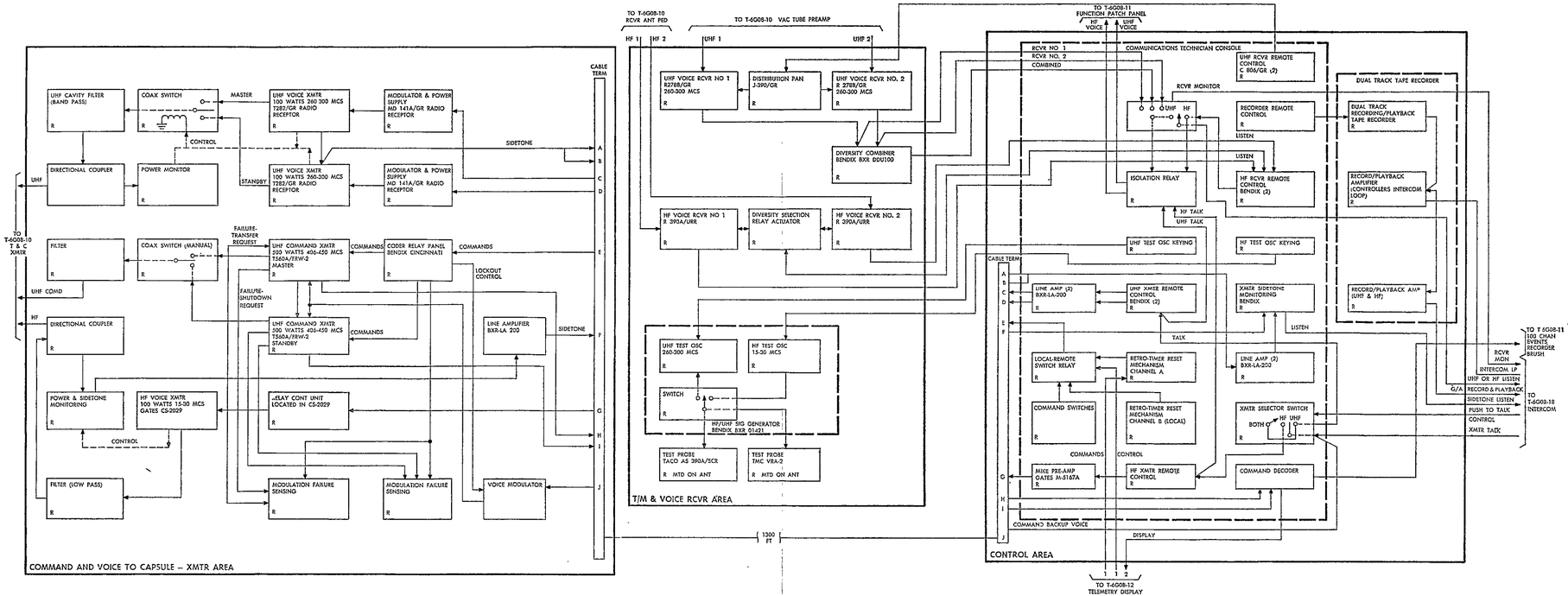


FIGURE 6-11. AIR-GROUND COMMUNICATIONS FACILITIES — MUCHEA

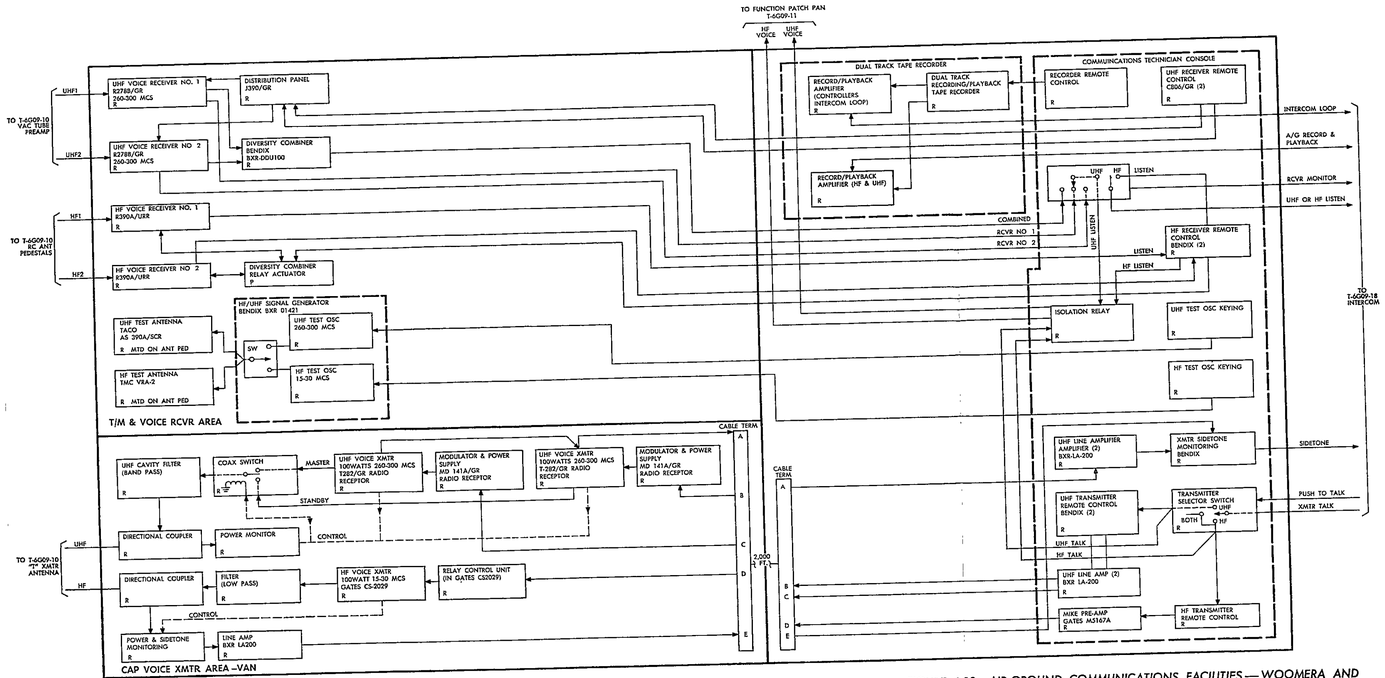


FIGURE 6-12. AIR-GROUND COMMUNICATIONS FACILITIES — WOOMERA AND CORPUS CHRISTI

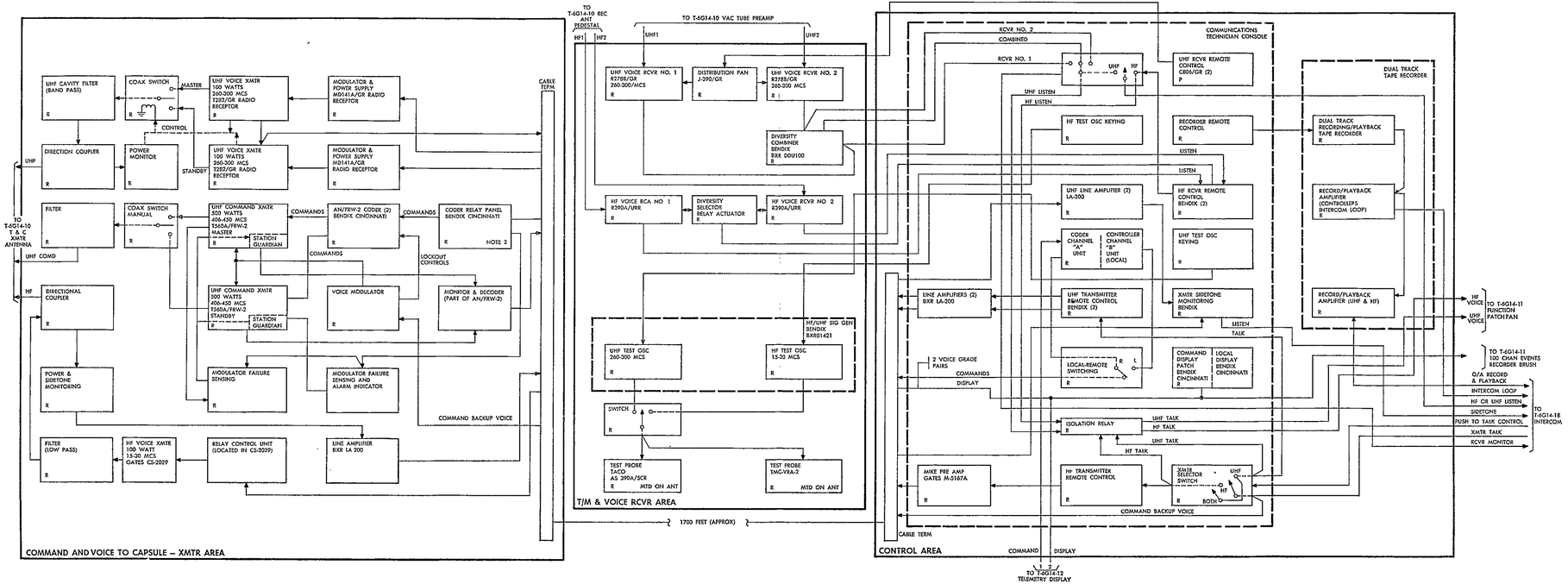


FIGURE 6-13. AIR-GROUND COMMUNICATIONS FACILITIES — GUAYMAS

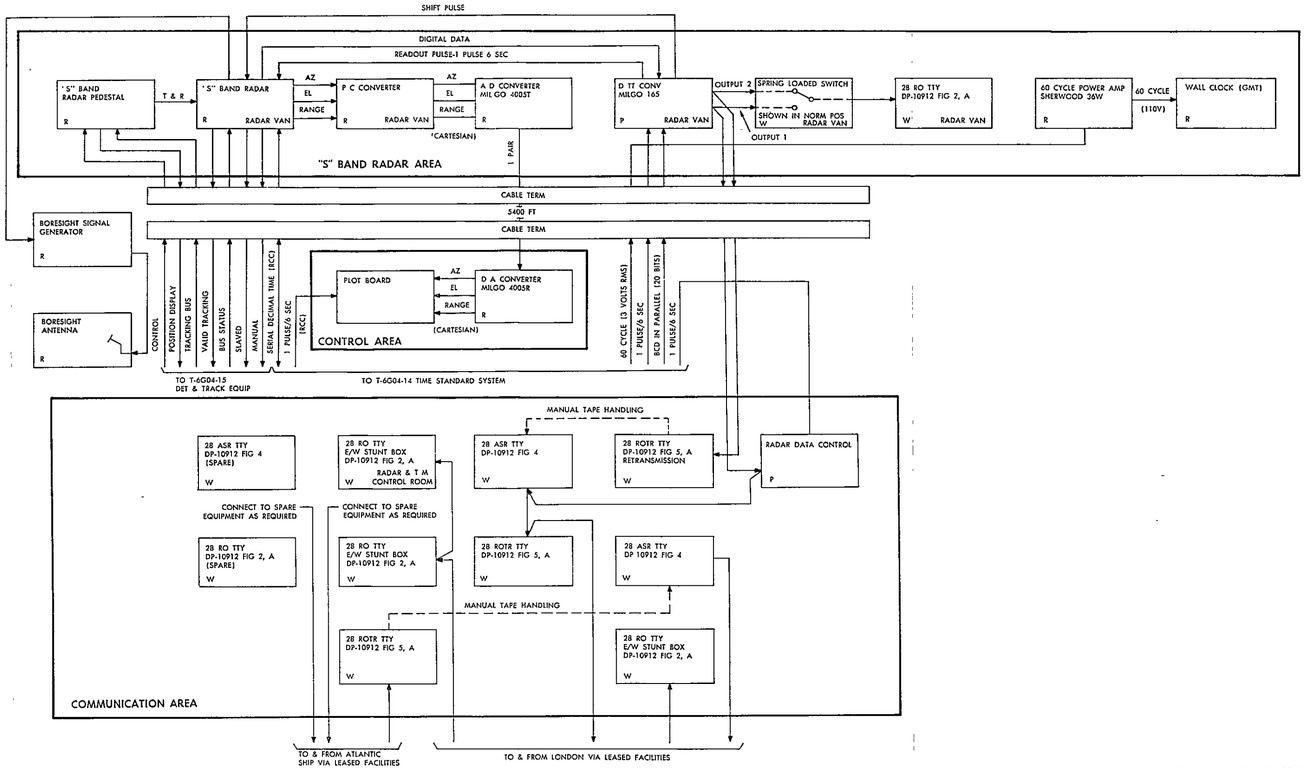


FIGURE 6-14. FUNCTIONAL BLOCK DIAGRAM, RADAR SYSTEM — GRAND CANARY ISLAND

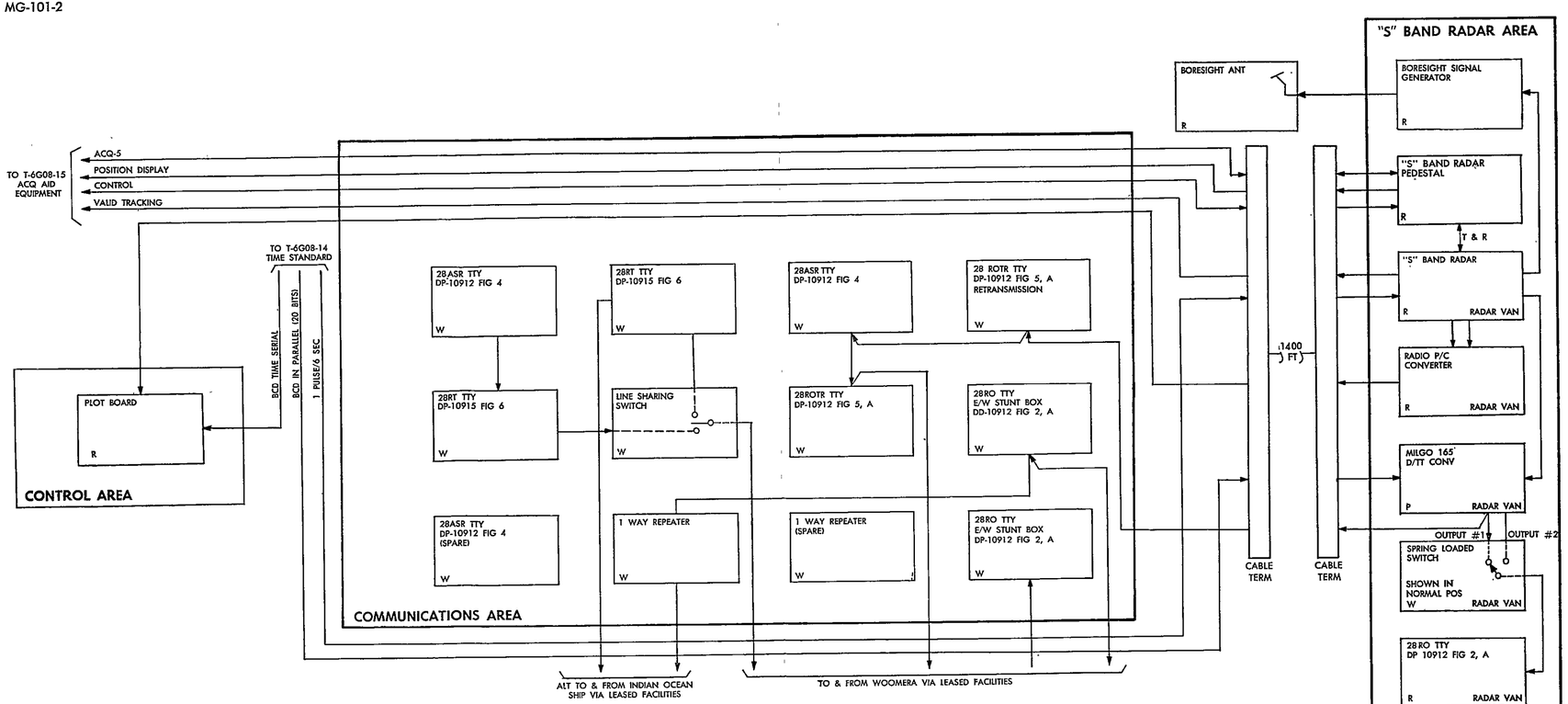


FIGURE 6-15. FUNCTIONAL BLOCK DIAGRAM, RADAR SYSTEM — MUCHEA, GUAYMAS, AND CORPUS CHRISTI

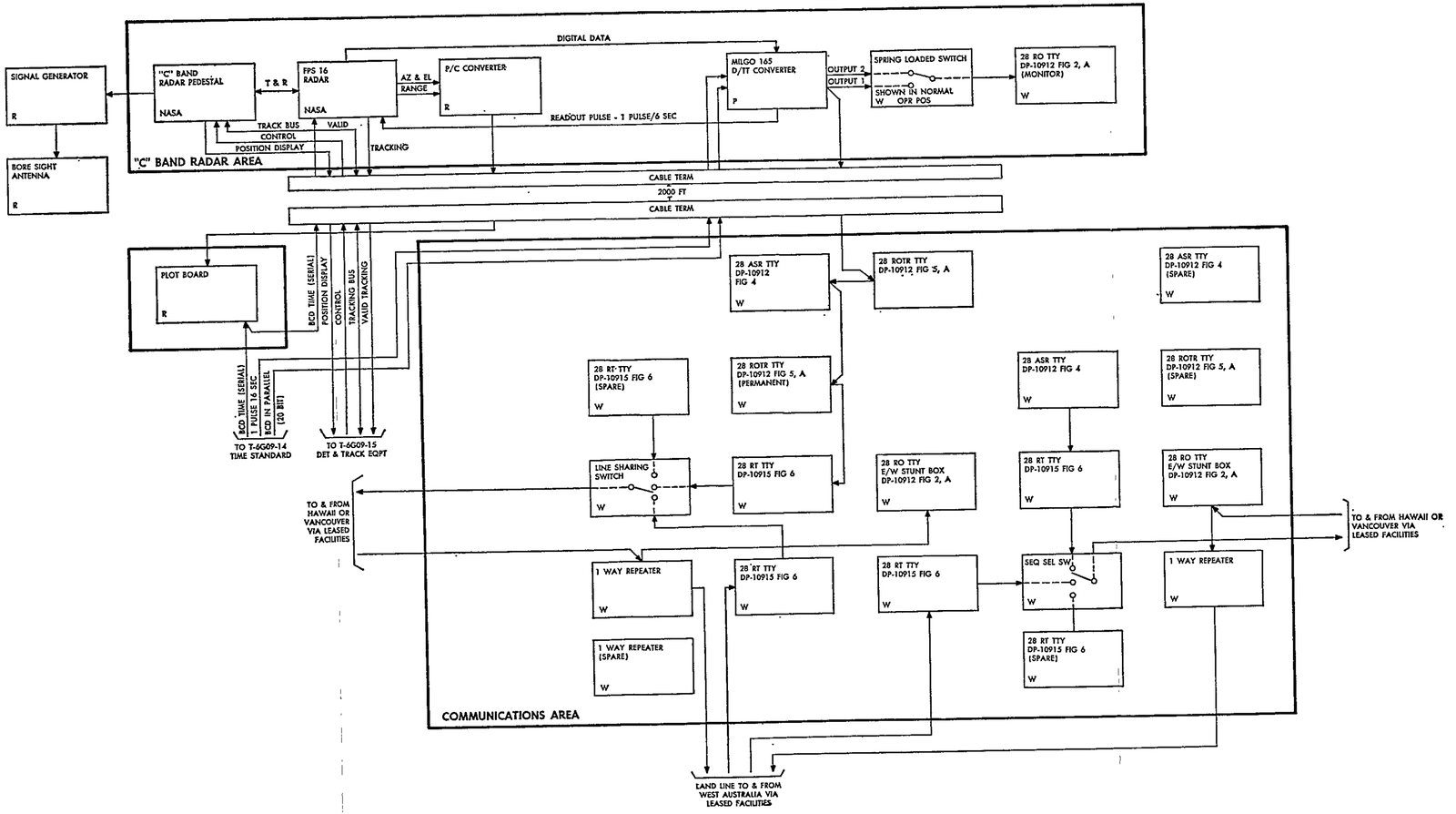


FIGURE 6-16. FUNCTIONAL BLOCK DIAGRAM, RADAR SYSTEM — WOOMERA

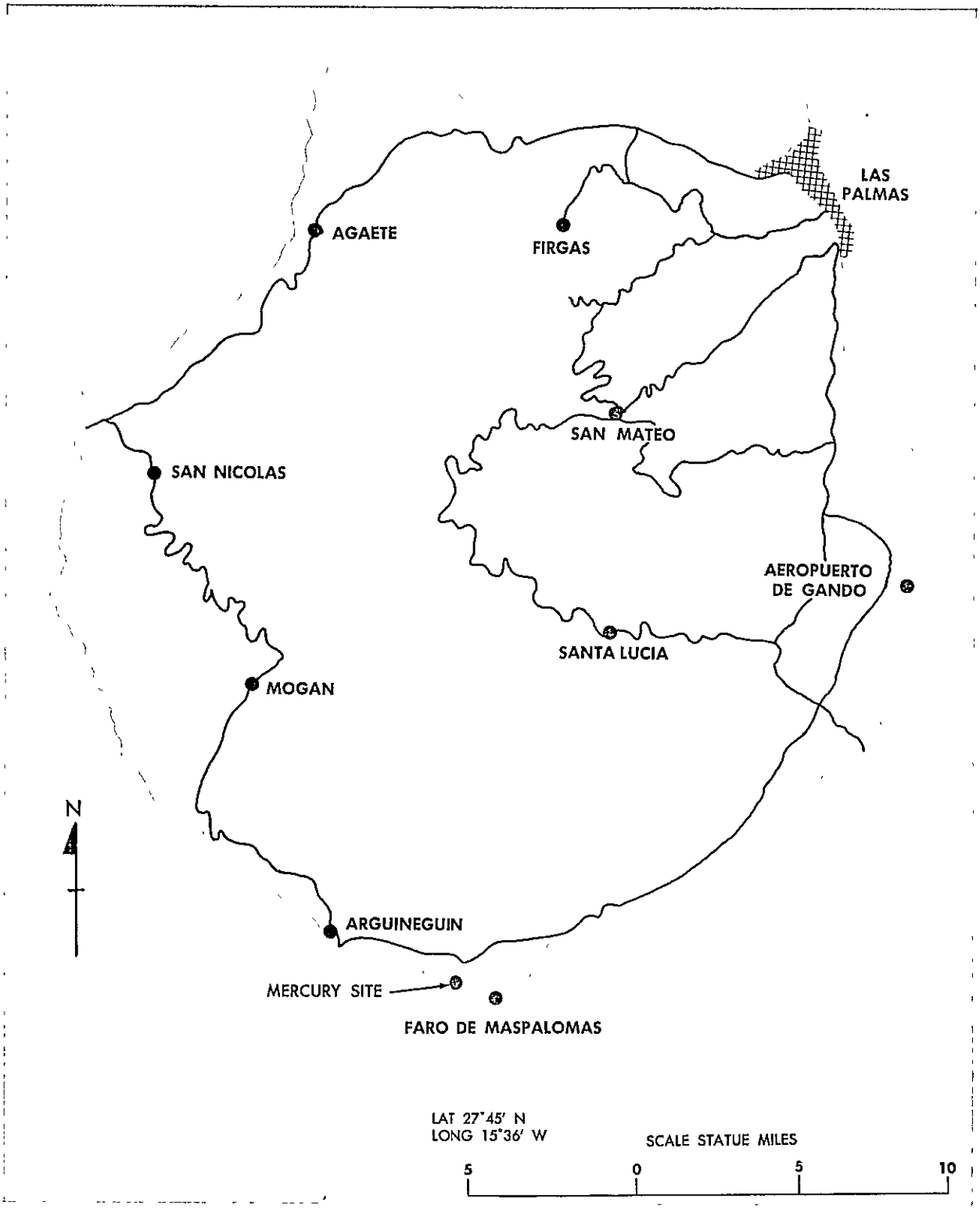


FIGURE 6-17. AREA MAP — GRAND CANARY ISLAND

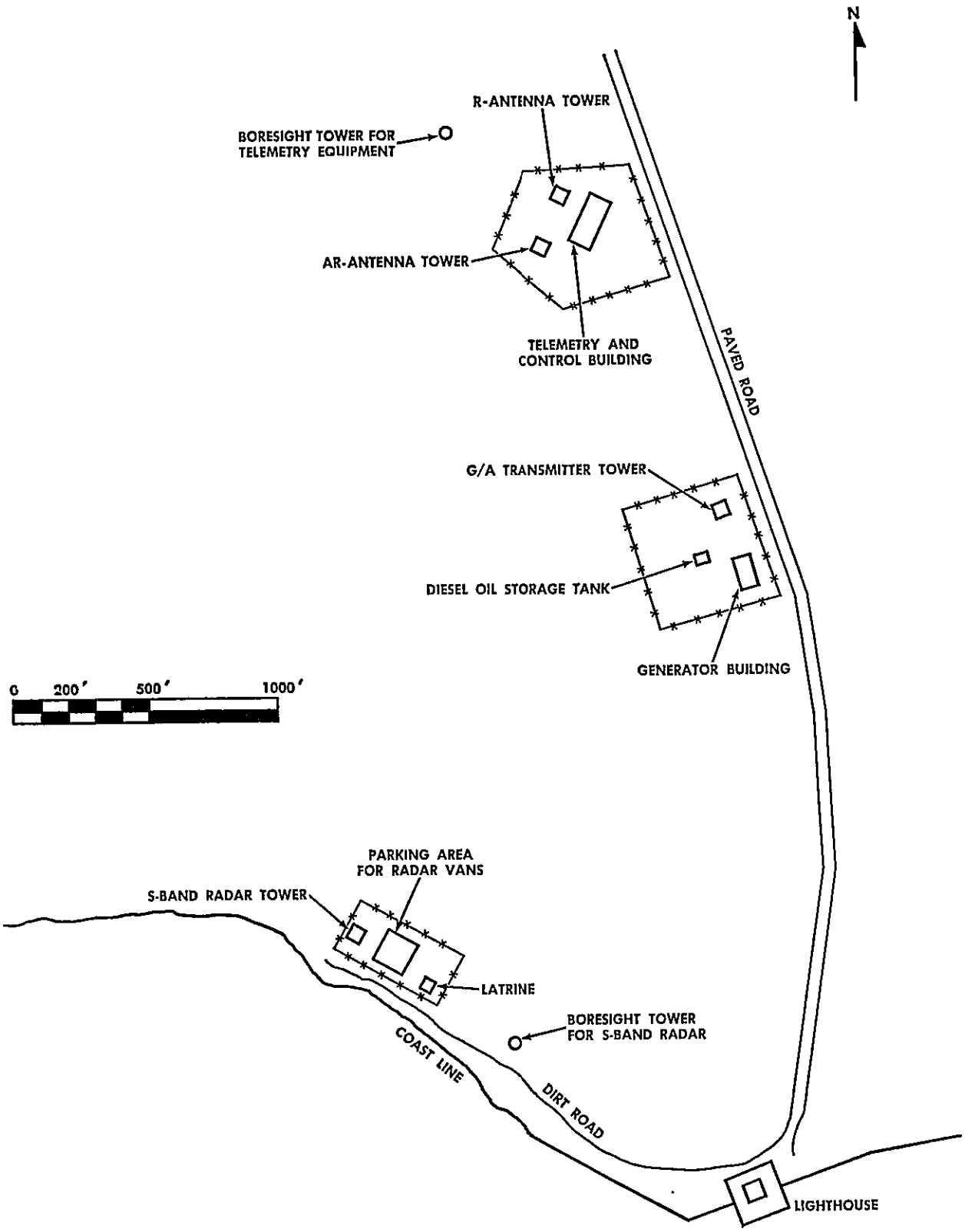


FIGURE 6-18. SITE PLAN — GRAND CANARY ISLAND

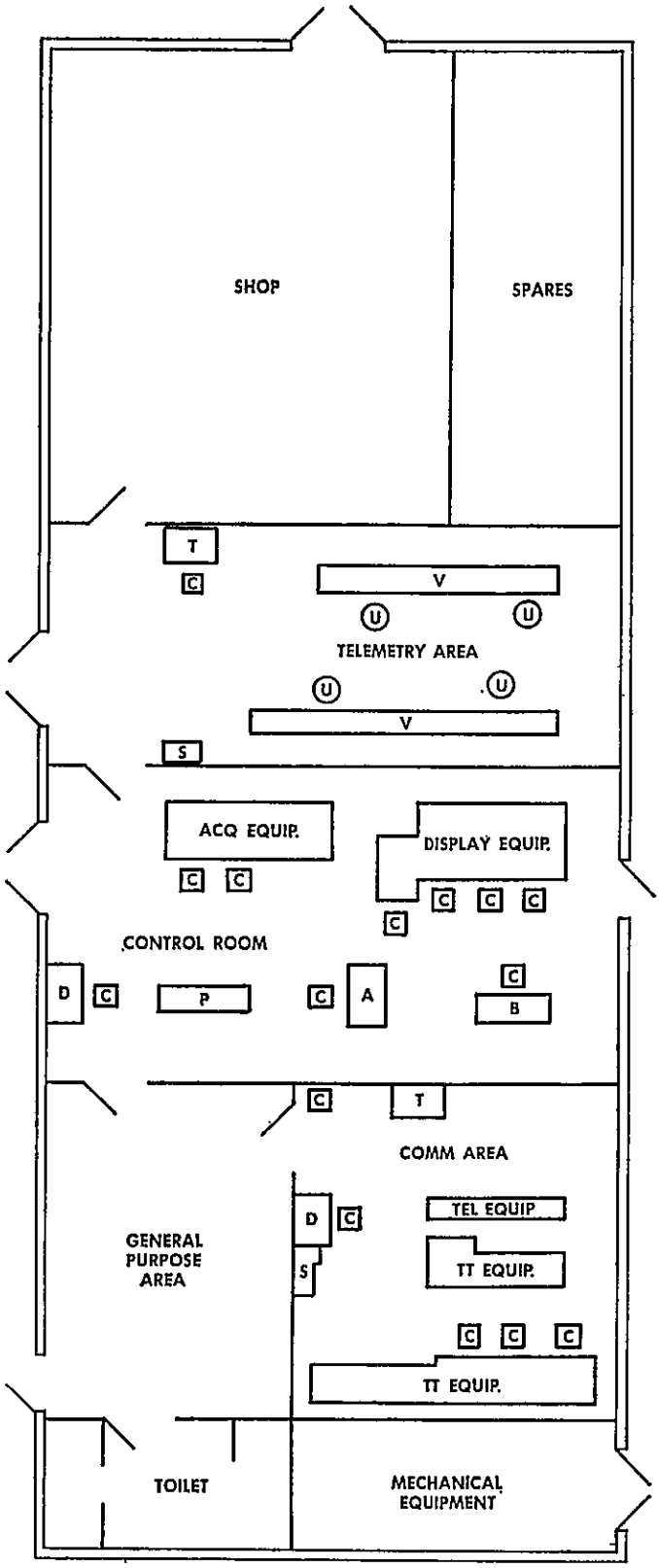


FIGURE 6-19. FLOOR PLAN — GRAND CANARY ISLAND

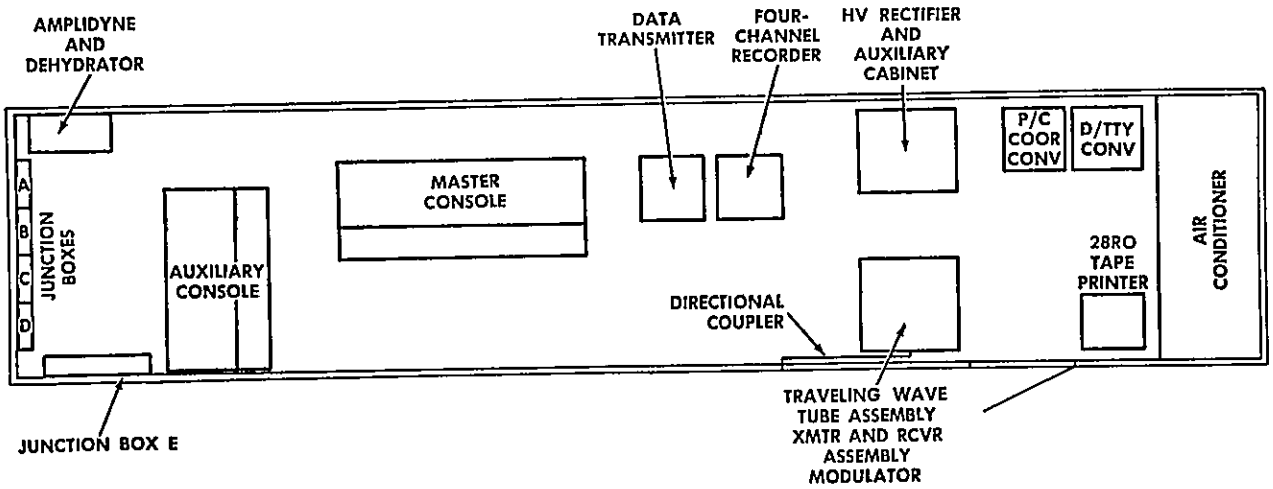


FIGURE 6-20. VERLORT RADAR VAN — GRAND CANARY ISLAND, GUAYMAS, MEXICO, KAUAI, AND CORPUS CHRISTI, TEXAS

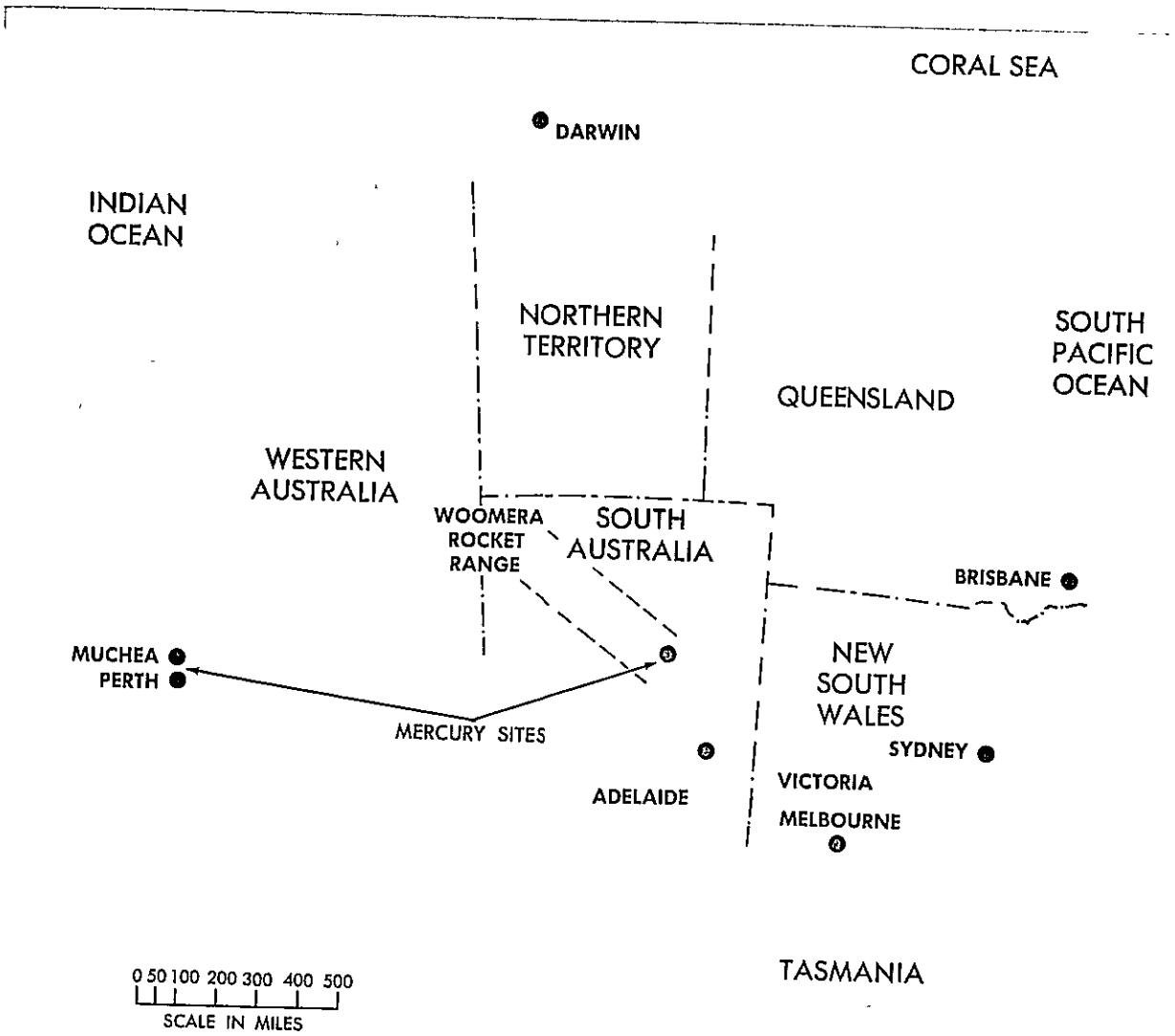


FIGURE 6-21. AREA MAP — MUCHEA AND WOOMERA, AUSTRALIA

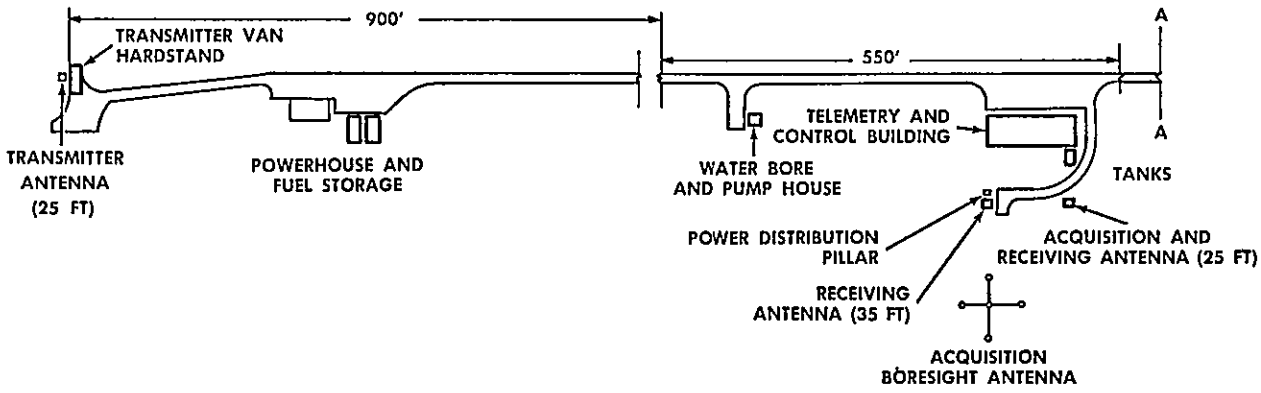


FIGURE 6-22A. SITE PLAN — MUCHEA

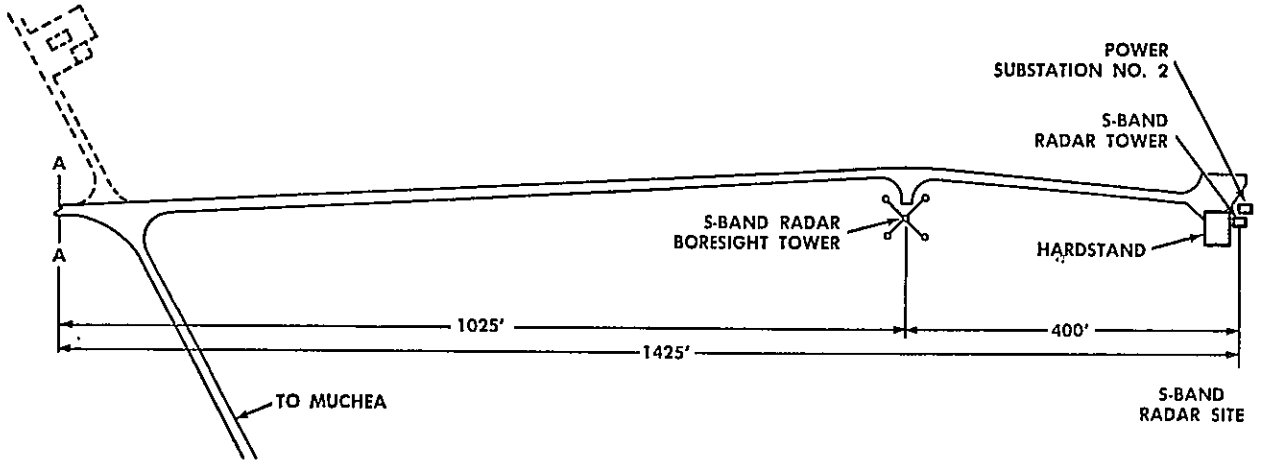
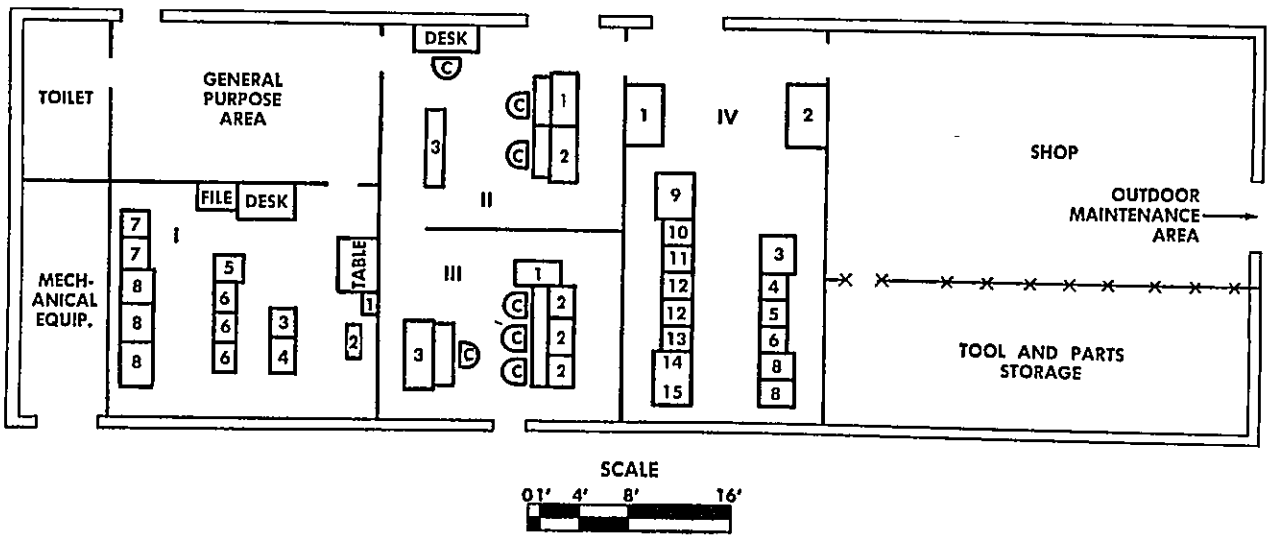


FIGURE 6-22B. SITE PLAN — MUCHEA



AREA I

1. LOOP SWITCHBOARD
2. DISTRIBUTING FRAME
3. MISCELLANEOUS POWER
4. 105D POWER PLANT
5. 28ROTR
6. RELAY RACKS
7. 28RO
8. 28ASR

AREA II

1. ACQUISITION DATA CONSOLE
2. ACQUISITION AID RECEIVER
3. PLOT BOARD

AREA III

1. DISPLAY RECORDER
2. FLIGHT CONTROLLER CONSOLE; CAPSULE COMMUNICATOR, AEROMEDICAL MONITOR, CAPSULE MONITOR
3. COMMUNICATIONS TECHNICIAN CONSOLE

AREA IV

1. STORAGE CABINET
2. WORK BENCH
3. TIMING STANDARD
4. DECOM MON
5. 90/90 DECOM
6. 90/15 DECOM
7. EVENTS RECORDER
8. PEN RECORDERS
9. VOICE RECEIVER
10. DISCRIMINATORS
11. CALIBRATOR
12. RECEIVERS
13. CONTROL
14. REPRO
15. TAPE RECORDER

FIGURE 6-23. FLOOR PLAN, TELEMETRY AND CONTROL AREA — MUCHEA

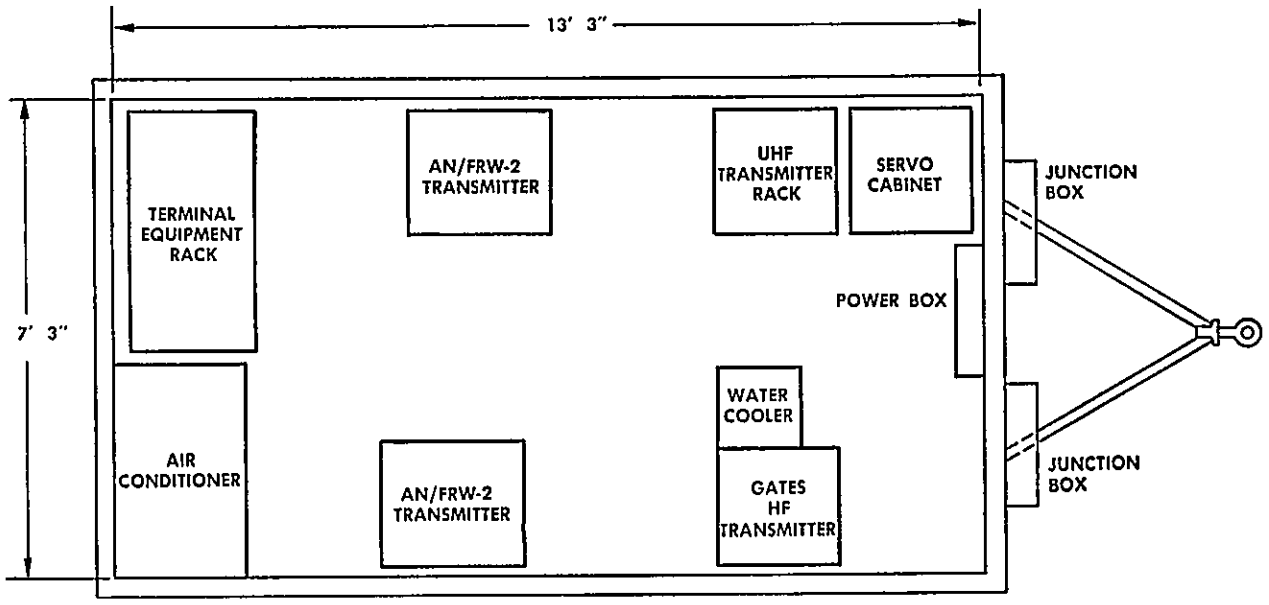


FIGURE 6-24. TRANSMITTER VAN — MUCHEA AND GUAYMAS

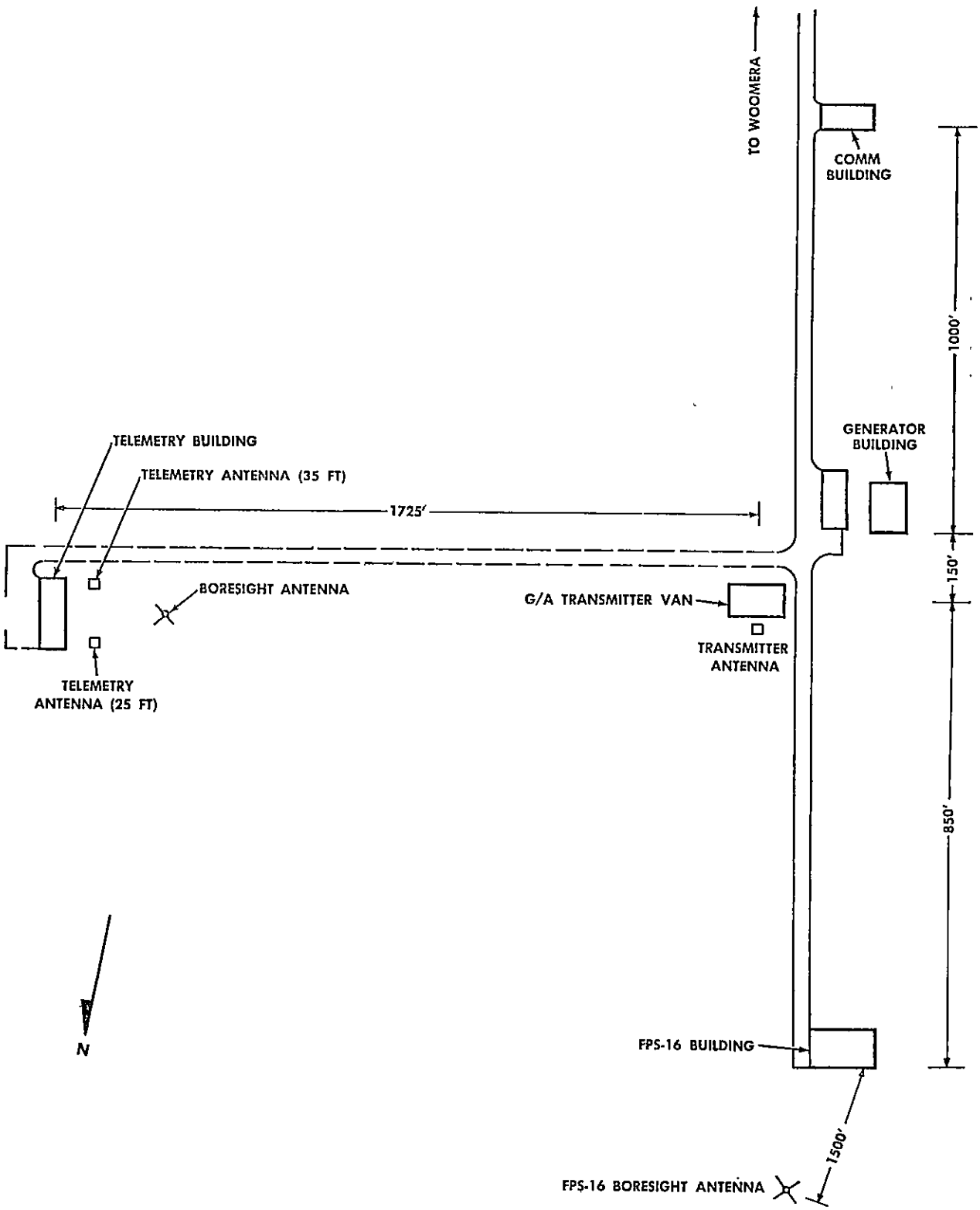
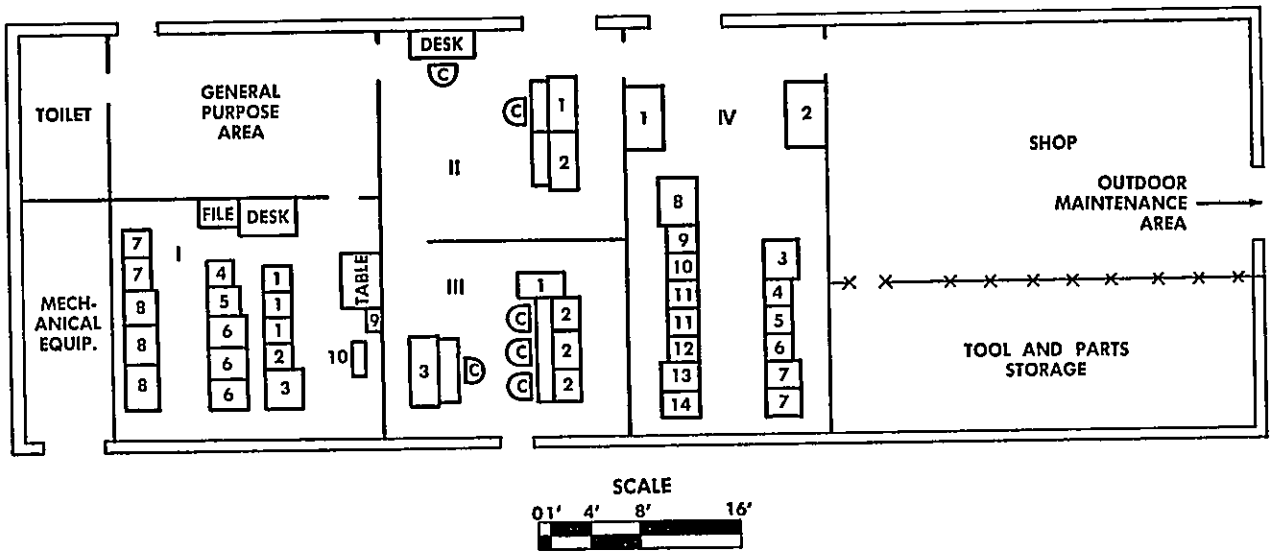


FIGURE 6-25. SITE PLAN — WOOMERA, AUSTRALIA



AREA I

1. RELAY RACK
2. MISCELLANEOUS POWER
3. 105D POWER PLANT
4. SEQUENTIAL SELECTOR
5. 28ROTR
6. 28RT
7. 28RO
8. 28ASR
9. LOOP SWITCHBOARD
10. DISTRIBUTING FRAME

AREA II

1. ACQUISITION DATA CONSOLE
2. ACQUISITION AID RECEIVER

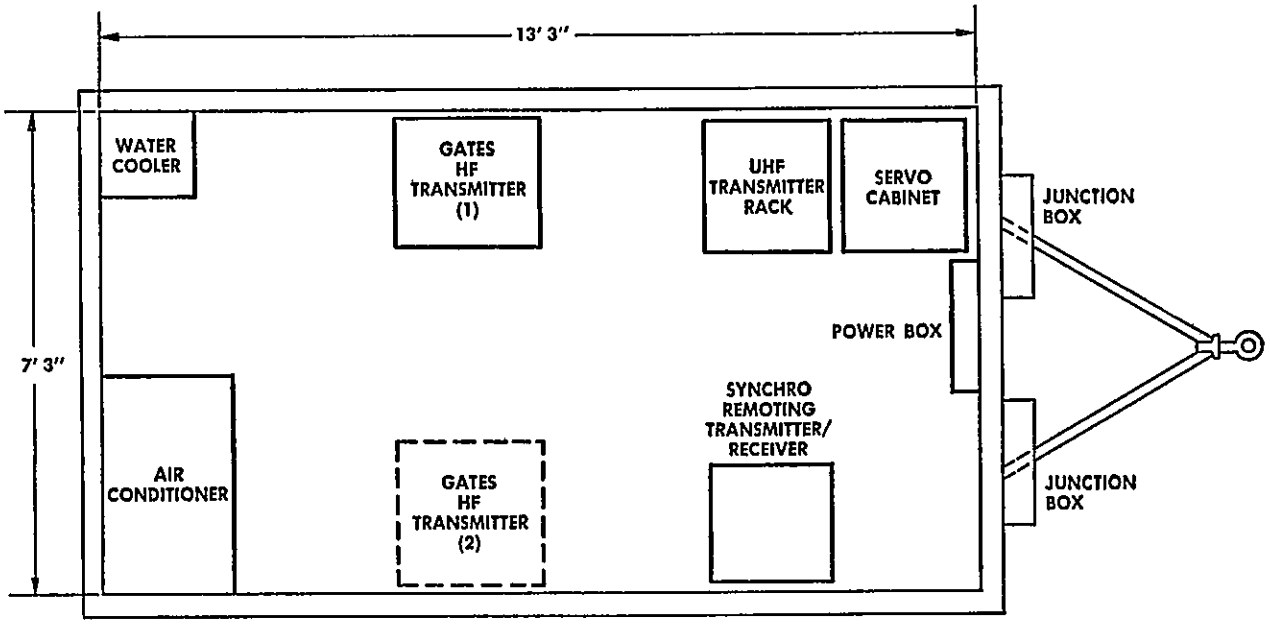
AREA III

1. DISPLAY RECORDER
2. FLIGHT CONTROLLER CONSOLE: CAPSULE COMMUNICATOR, AEROMEDICAL MONITOR, CAPSULE MONITOR
3. COMMUNICATIONS TECHNICIAN CONSOLE

AREA IV

1. STORAGE CABINET
2. WORK BENCH
3. TIMING STANDARD
4. DECOM MONITOR
5. 90/90 DECOM
6. EVENTS RECORDERS
7. PEN RECORDERS
8. VOICE RECEIVERS
9. DISCRIMINATOR
10. CALIBRATOR
11. RECEIVERS
12. CONTROL
13. REPRO
14. TAPE RECORDER

FIGURE 6-26. FLOOR PLAN, TELEMETRY AND CONTROL AREA — WOOMERA



NOTE: TRANSMITTER (2) AT GRAND CANARY ONLY.

FIGURE 6-27. TRANSMITTER VAN — CORPUS CHRISTI, WOOMERA, POINT ARGUELLO, AND GRAND CANARY ISLAND

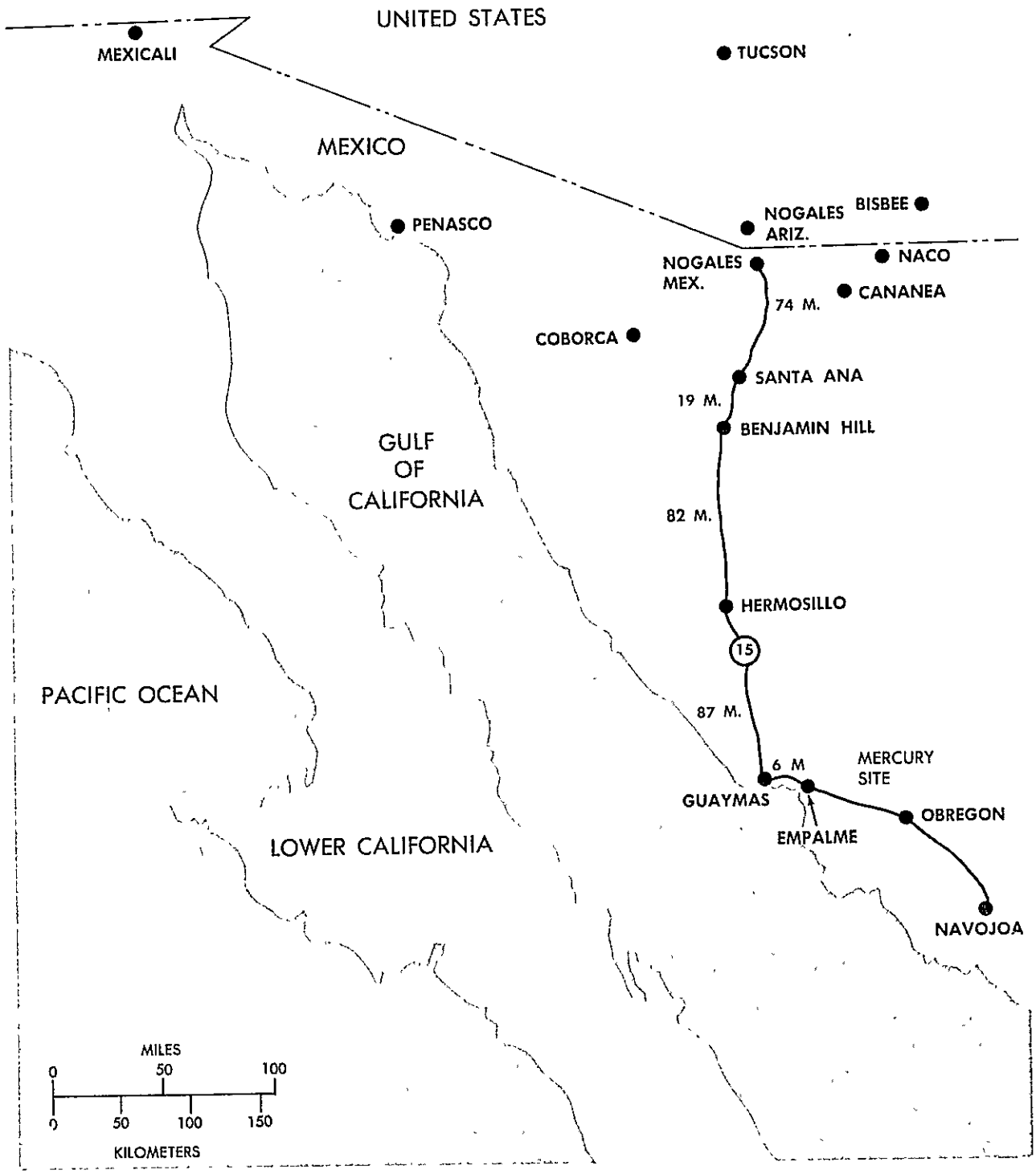


FIGURE 6-28. AREA MAP — GUAYMAS, MEXICO

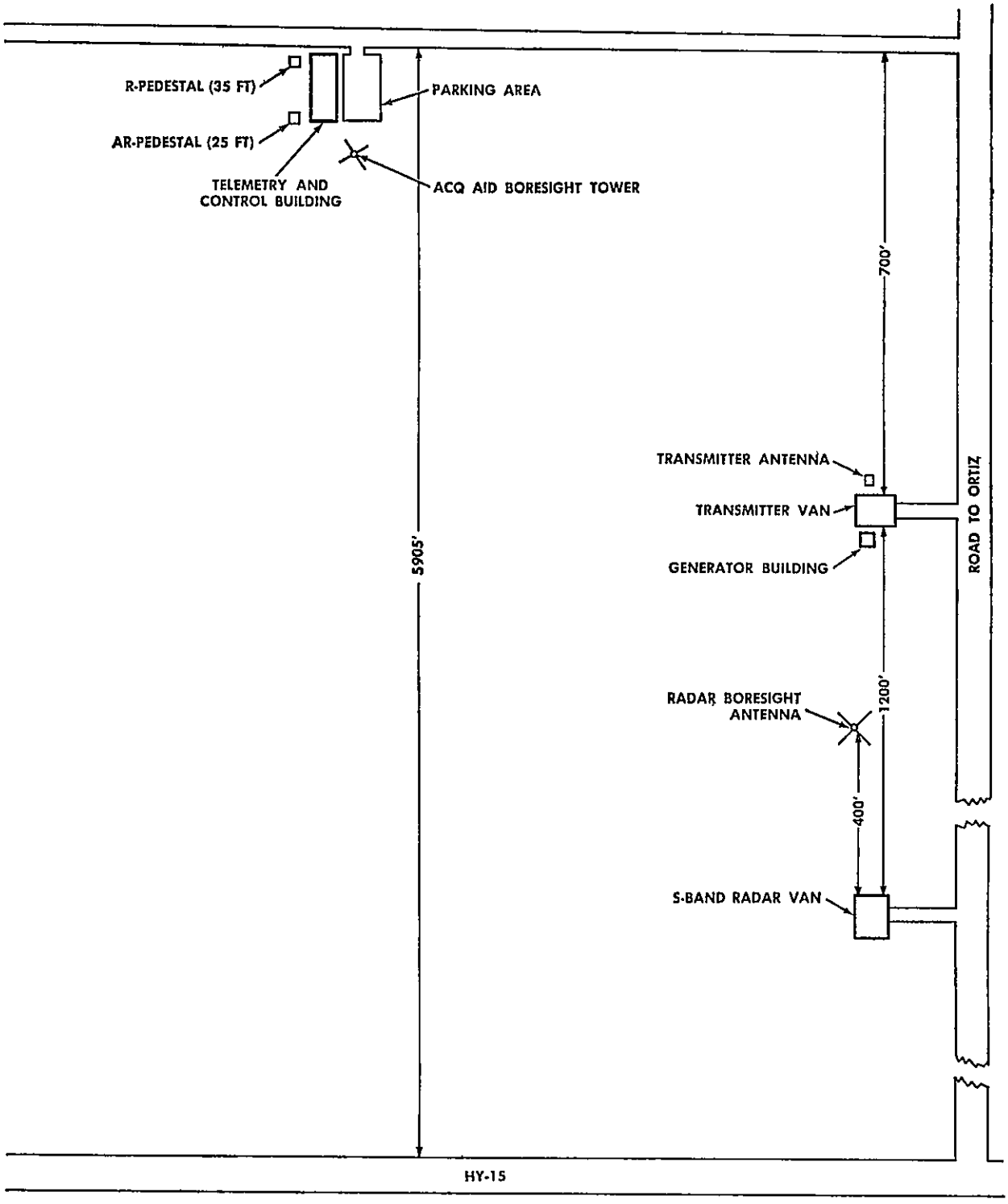
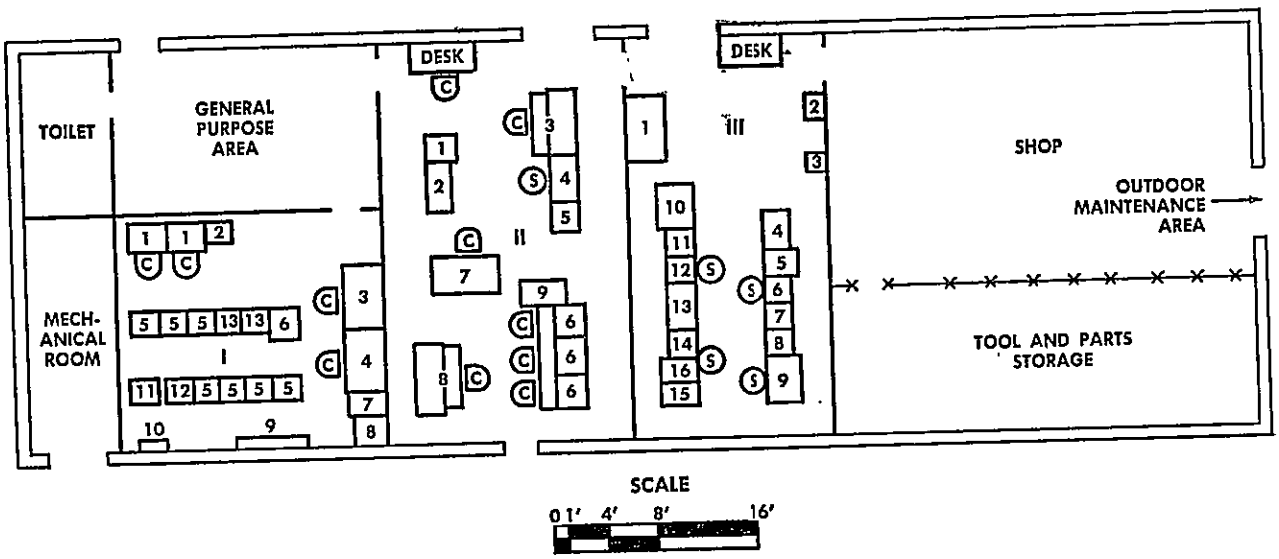


FIGURE 6-29. SITE PLAN — GUAYMAS, MEXICO



AREA I

1. 28ASR
2. 28RO
3. DESK
4. WORK TABLE
5. 112 KEY EQUIPMENT
6. 28ROTR
7. FILE
8. STORAGE CABINET
9. DISTRIBUTING FRAME
10. POWER DISTRIBUTION PANEL
11. 105D POWER PLANT
12. FUSE BAY
13. C-CARRIER

AREA II

1. POLAR-CARTESIAN CONVERTER
2. PLOT BOARD
3. ACQUISITION DATA CONSOLE
4. ACQUISITION AID EQUIPMENT
5. SERVO
6. COMMAND STATION DISPLAYS
7. M & O SUPERVISOR DESK
8. COMMUNICATIONS TECHNICIAN CONSOLE
9. DISPLAY RECORDER

AREA III

1. WORK BENCH
2. POWER PANEL
3. LIGHT PANEL
4. TIMING STANDARD
5. DECOM MONITOR
6. 90-90 DECOM
7. 90-15 DECOM
8. RECORDER
9. PEN RECORDERS
10. VOICE RECEIVERS
11. DISCRIMINATORS
12. CALIBRATOR
13. RECEIVERS
14. CONTROL
15. RECORDERS
16. REPRODUCER

FIGURE 6-30. FLOOR PLAN, TELEMETRY AND CONTROL AREA — GUAYMAS, MEXICO

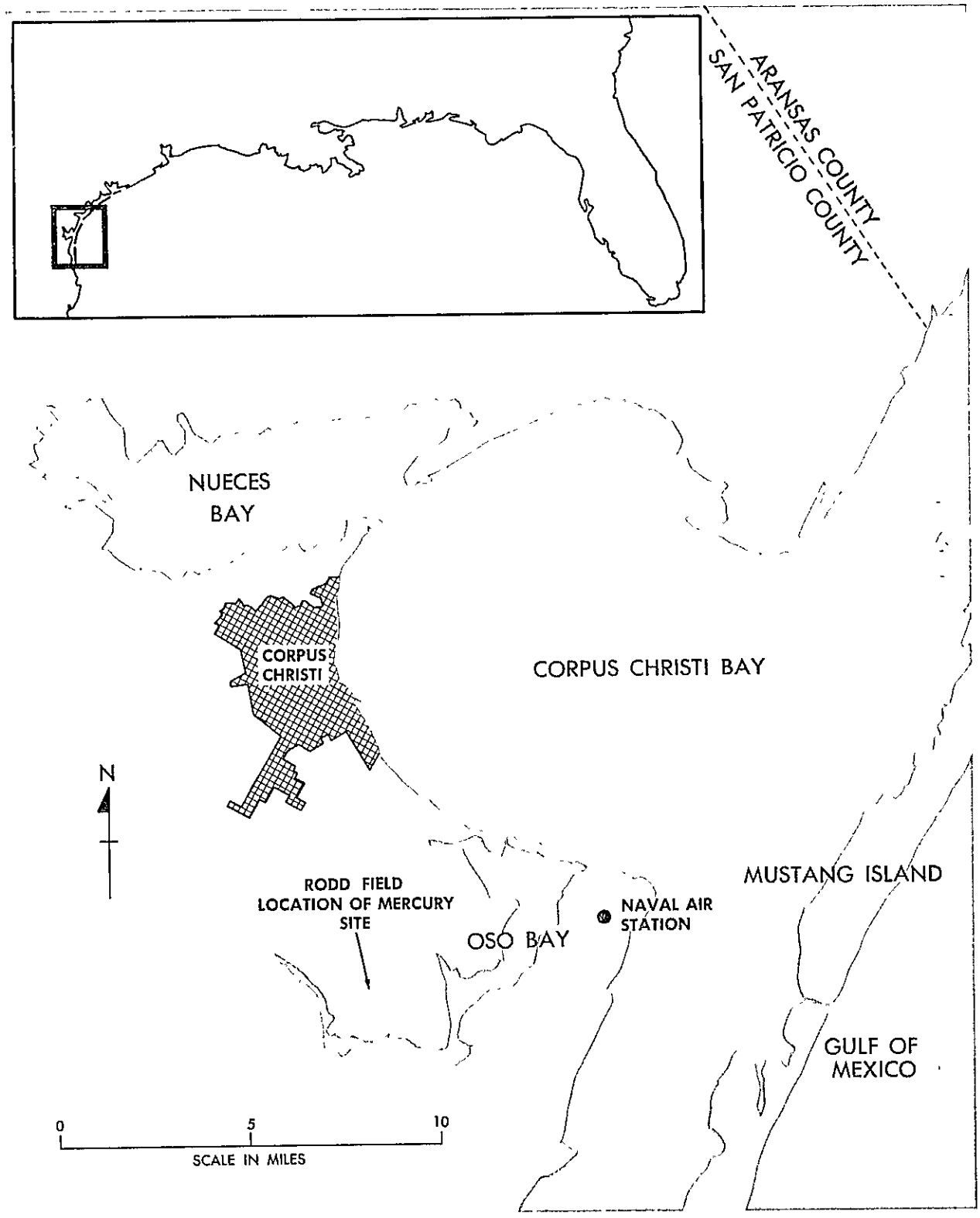


FIGURE 6-31. AREA MAP — CORPUS CHRISTI, TEXAS

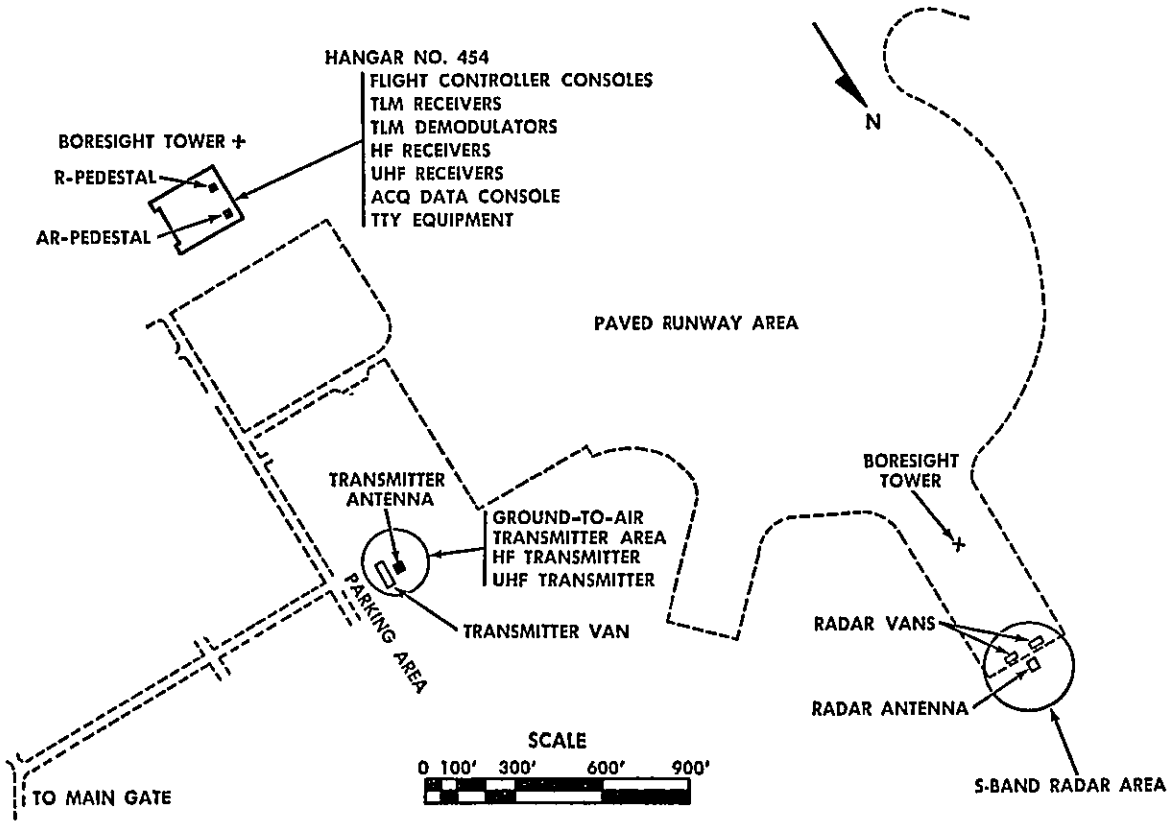


FIGURE 6-32. RODD FIELD, SHOWING MERCURY AREAS

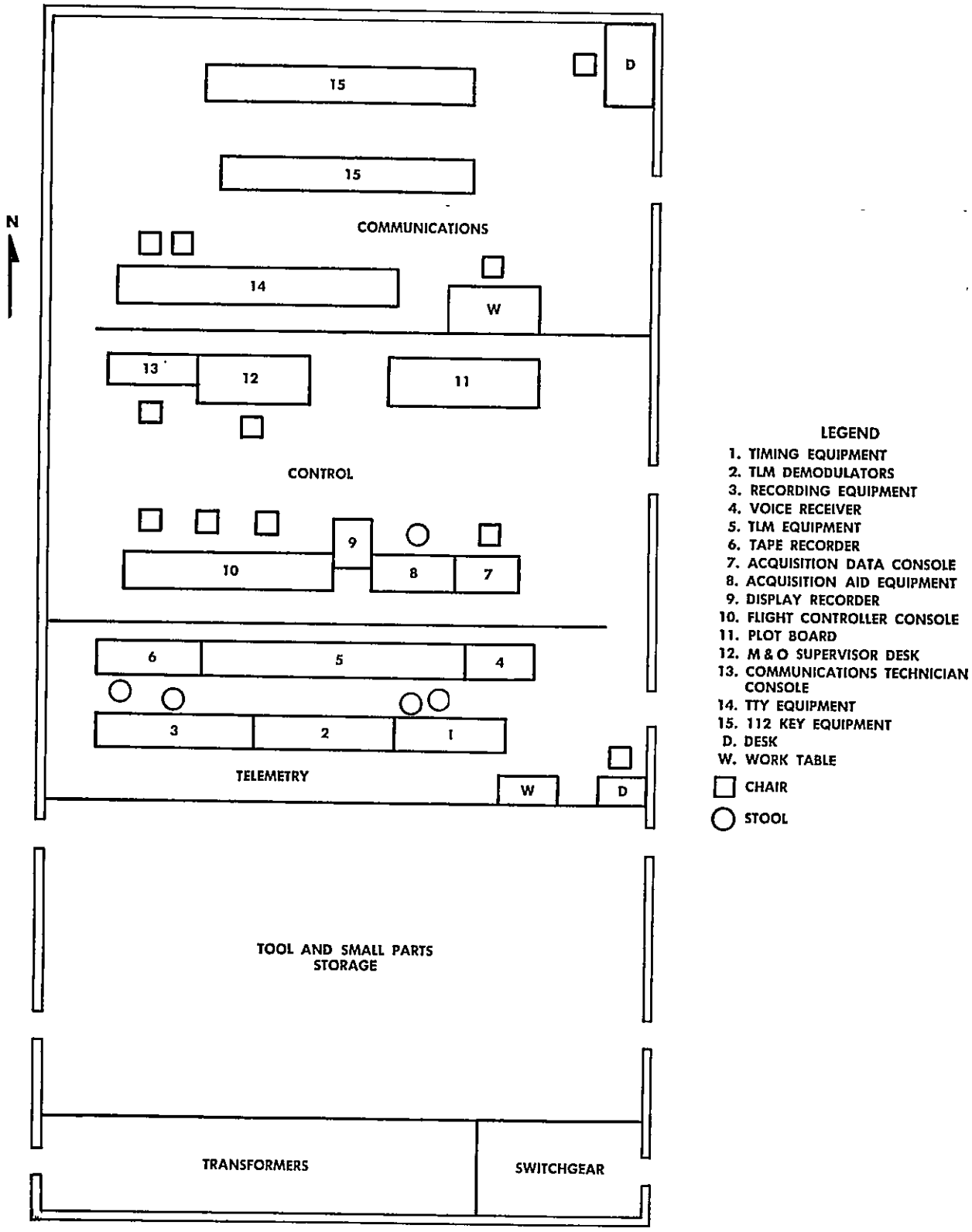
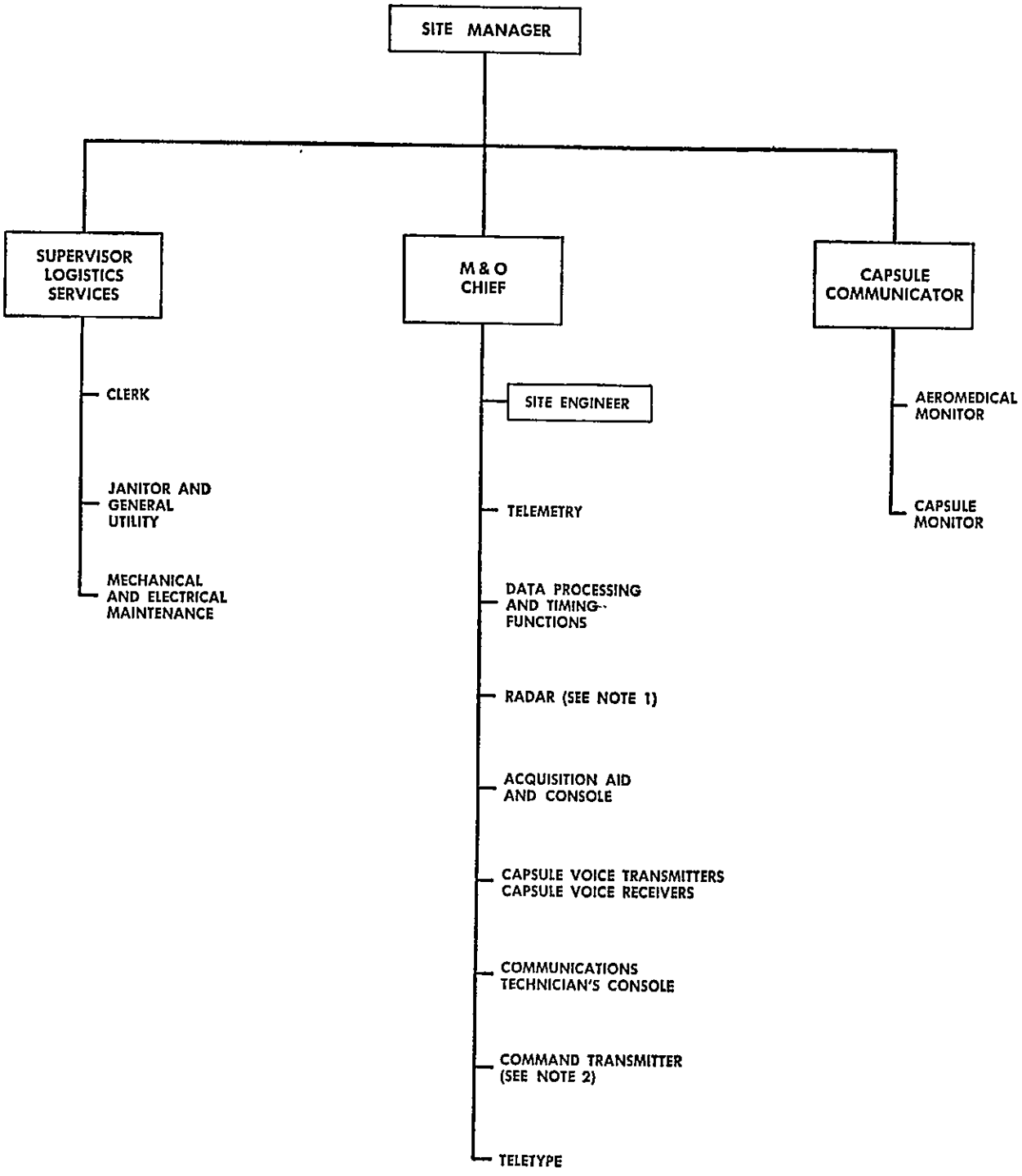


FIGURE 6-33. TELEMETRY AND CONTROL AREA — CORPUS CHRISTI



NOTES
1. FPS-16 AT WOOMERA. VERLORT AT THE OTHER SITES
2. LOCATED AT MUCHEA AND GUAYMAS ONLY

FIGURE 6-34. SITE ADMINISTRATION

Section 7
KAUAI

TABLE OF CONTENTS

Paragraph	*Title*	*Page*
7.1	Purpose of the Site	7-1
7.2	Systems	7-1
	Ground Communications System	7-1
	Timing System	7-1
	Acquisition System	7-2
	Telemetry System	7-3
	Capsule Communication System	7-3
	Radar System	7-4
	Command Transmitting System	7-4
7.3	Equipment Allocations	7-5
7.4	Equipment Locations	7-5
7.5	Site Administration	7-5
7.6	Geographic and Climatic Data	7-5
7.7	Transportation and Communications	7-5
7.8	Site Personnel Facilities and Services (Housing, Medical Facilities, Recreational Facilities, Mail Service, Religious Facilities, Clothing, and Food)	7-7
7.9	Miscellaneous Information (Money, Taxes, and Immunization Requirements)	7-7

LIST OF ILLUSTRATIONS

Figure	*Title*	*Page*
7-1	Master Functional Block Diagram —Hawaii	7-9
7-2	Functional Block Diagram, Acquisition System—Hawaii	7-10
7-3	Functional Block Diagram, Air-Ground Communications — Hawaii	7-11/12
7-4	Transmitter Van—Hawaii; Zanzibar; Canton Island; Kano, Nigeria	7-13
7-5	Floor Plan, UHF Command Transmitter Vans—Hawaii	7-15
7-6	Functional Block Diagram, Antenna System—Hawaii	7-16
7-7	Functional Block Diagram, Radar System—Hawaii	7-17
7-8	Command Transmitter System—Hawaii	7-19
7-9	Area Map—Hawaii	7-20
7-10	Project Mercury—Hawaii	7-21
7-11	Location Map—Hawaii	7-22
7-12	Site Plan, S-band Radar Area—Hawaii	7-23
7-13	Site Plan, Telemetry and Control Area—Hawaii	7-24
7-14	Floor Plan, Telemetry and Control Area—Hawaii	7-25
7-15	Site Administration—Hawaii	7-26

LIST OF TABLES

Table	*Title*	*Page*
7-1	Equipment Allocations — Kauai, Hawaii	7-6

SECTION 7. KAUAI, HAWAII

7-1 PURPOSE OF THE SITE

In addition of the functions and systems noted in Figure 1-1, this site is important to Project Mercury because the command issued by radio from this site resets the timers in the capsule which are used to actuate the capsule retrorockets. Precisely timed firing of these rockets is essential to recovery of the capsule in the specified area.

7.2 SYSTEMS

See Figure 7-1 for a master functional block diagram of the site.

7.2.1 Ground Communications System

Intersite communications are made possible by voice and teletype circuits to the Goddard Space Flight Center. Facilities provided accommodate one voice and two two-way teletype circuits, plus an administrative circuit that can also serve as a spare facility for either a voice or a teletype channel. An additional line is provided to the nearest central office of the Hawaiian Telephone Co., which can be connected to the usual telephone network of the Hawaiian Islands and beyond. The circuits are routed by telephone wire facilities to a telephone radio transmitter on Kauai Island. The radio path extends from Lihue, on Kauai Island, to Mauna Kapu on Oahu Island, where the circuits are retransmitted by another radio link to the main office of the Hawaiian Telephone Co. From this point the voice circuit in use is transmitted by the telephone submarine cable to San Francisco and thence by other leased telephone facilities to the Goddard Space Flight Center and to the Mercury Control Center at Cape Canaveral. The teletype circuits follow an identical path from the telephone office at Oahu to their terminations in the United States, except that the nonradar teletype data circuit is processed through line-sharing equipment in the Oahu telephone office. This equipment allows the use of one transmission facility from Hawaii to the United States by more than one site on a sequential basis, thus reducing the necessity for having many facilities for transmission of Mercury teletype messages from Hawaii to the United States. See Figure 6-5. The nonradar circuit from Kauai is processed through equipment shared by circuits carrying radar data from Muchea, teletype summaries from Woomera, and teletype summaries from Canton Island. The radar data teletype message is not processed by this equipment, but is connected directly to the Hawaii-U.S.A. submarine cable.

The spare voice circuit from Kauai Island, terminated in the telephone office at Oahu, is available for either voice or teletype use to the United States on an emergency basis. The local exchange telephone circuit on Kauai Island connects to the local telephone system at the Kekaha (Kauai Island) telephone central office.

The teletype circuits are capable of transmitting 60 words per minute in both directions simultaneously (full-duplex circuits). See Figure 1-3 for the intersite communications network.

An intercommunication system is provided for operational and administrative messages between Mercury personnel. See Figure 1-2 for a typical functional block diagram of the interconnections between the Capsule Communicator, Aeromedical Monitor, and Capsule Monitor, as well as the interconnection of other circuits between the Maintenance and Operating (M&O) Supervisor, communications technician console, and various other maintenance and operating personnel locations.

Functions of particular interest in this system are the ability to:

a. Talk or monitor on the ground-air radio circuit;

b. Talk or monitor on local conference circuits;

c. Talk to the various technicians, independently of the operational circuits used by the Flight Controllers.

A private branch exchange (PBX) switchboard is used for routine communications throughout the site, with a PBX trunk supplied for access to local exchange services.

7.2.2 Timing System

The timing system provides time correlation of data collected from radar and telemetry systems, and it provides a driving source for the control area time displays. The time reference used is that of Greenwich Mean Time (GMT) expressed in hours, minutes, and seconds. See

Figure 6-6 for a block diagram of a typical timing system.

A receiver is tuned to the frequency of WWV (the Bureau of Standards radio station). Signals received from this station are used as a reference standard against which a stable one-megacycle oscillator is compared and adjusted, so that the frequency of the signal generated by it agrees with the frequency of the incoming signal. This comparison is accomplished at a convenient point in the circuits of the site's timing system, which supplies various output frequencies from 1 kc to one cycle per minute by frequency dividing circuits. A check of the system is provided by a visual comparison on an oscilloscope of the one-pulse-per-second output of the timing system and the once-per-second tone burst of WWV.

Important outputs of this system are as follows.

a. An output representing the GMT in hours, minutes, and seconds, is used in the data processing and data conversion equipment to time-tag radar data, and to drive certain time displays.

b. A pulse from the timing equipment every six seconds causes radar data to be read out.

c. The telemetry data is time-tagged for teletype transmission. Time reference is GMT, which is delivered in the serial form (sequential rather than simultaneous) of a ten-pulse-per second pulse train.

7.2.3 Acquisition System

The function of the acquisition system (essentially an antenna pointing device) is to aid the antennas associated with the site subsystems to acquire signals emanating from the capsule (Figure 7-2).

Proper functioning of the system depends on error voltages. These voltages are developed by measurement of the time difference at which the signal transmitted by the capsule arrives at the different elements of a special antenna provided for this purpose. The magnitude of these error voltages is greater as the antenna points away from the capsule and least when the antenna is aimed directly at the source of the signal.

The difference in arrival time of the signal at the antenna elements (phase difference) is measured by an acquisition aid receiver which is especially designed for this purpose.

Error voltages developed by this system are amplified and displayed on appropriate meters to aid a system operator in manually correcting the antenna position until antenna pointing error is at a minimum, as evidenced by minimum error-voltage indications. When the antenna pointing is done automatically by the system, the error voltages are applied directly to the antenna pedestal, repositioning the antenna to keep it pointed at the target.

Two types of consoles are provided for system operation at these sites:

a. The *active acquisition aid control console* controls the operation of the active acquisition aid and the manual, automatic, or slaved operation of the acquisition aid antenna. These types of operation are defined as follows.

(1) Manual operation is the control of antenna position with handwheels on the console. Visual indications are provided to show the azimuth and elevation coordinates selected with the handwheels provided on this unit.

(2) Automatic operation is the control of antenna position by the active acquisition aid receiver without manual assistance. Control is accomplished by the directional-sensing capabilities of a quad-helix antenna array (on the AR-pedestal) associated hybrid, and acquisition receiver. A telemetry signal is converted into antenna positioning voltages after processing through this equipment.

(3) Slaved operation is the control of the acquisition aid antenna by positioning voltages supplied by other antennas on the site, as from the radar antennas. Signal strength meters, provided on this console, aid selection of the stronger of the two telemetry frequencies transmitted by the capsule. The strength of the signal received through the acquisition aid receiver is also indicated by a signal strength meter. Error voltages, indicating the correction voltages applied to the acquisition aid antenna pedestal, are displayed on this console.

b. The *acquisition data console* indicates the control mode (manual, automatic, or slaved) and the azimuth and elevation of the various steerable antennas at the site. The acquisition

data console allows any of the steerable antennas at the site to be slaved to the source furnishing the most accurate tracking information

Cablewrap indicators (lamps on the console) are also supplied to indicate when antenna rotation is either clockwise or counterclockwise from its resting point and towards rotational limits which are established because of the permanent connection of antenna cable to the antenna. "Valid tracking" lamps are also supplied. Their function is in the description of system operation. Since the acquisition aid antenna receiving pattern has a 20-degree beamwidth, the acquisition system is capable of acquiring the target early and furnishing refined capsule position information to all other steerable antenna pedestals at the site. Since the area to be searched is greatly decreased, radar equipments with beamwidths of less than 3 degrees may now acquire the target more readily.

System operation is as follows.

An operator receives an acquisition message which gives the expected coordinates (azimuth and elevation) and the expected time of arrival of the capsule at the site's geographical location. Additional messages also sent to these sites indicate the expected coordinates at one-minute intervals after the time of the capsule's arrival. The operator positions his handwheels until the appropriate indicators show that the antennas are pointed toward the coordinates given in the acquisition message. When the capsule signals are received by the system, manual corrections of antenna position are made to obtain minimum error-voltage indications on the appropriate meters. The system is then placed in AUTOMATIC operation, and the antennas follow the capsule position automatically.

While in the automatic mode of operation, the system continues to automatically track the capsule while the capsule remains within radio range of the sites. Valid tracking signals (lamps on the acquisition data console) are lighted to indicate when either type of radar is tracking the capsule automatically. The Acquisition Data Console Operator then selects the radar which is tracking the capsule most accurately to control the aiming of the other site antennas through a master control circuit provided in the system. This control circuit causes all antennas under control of the system to follow or slave to the control source chosen by the Acquisition Data Console Operator. The acquisition system also continues to track the capsule independently throughout the pass so that control of the site antennas can be restored to the system if the radar should lose the capsule at any time.

7.2.4 Telemetry System

See Figure 6-9 (in Section VI of this handbook) for a functional block diagram.

System operation is as follows.

Two quad-helix antenna arrays, each located on a separate pedestal, are used to obtain both height and space diversity. Four receivers are arranged in two pairs, with each pair tuned to one of the two selected frequencies in the 225-260 megacycle band. The outputs of each pair of receivers are fed into a diversity combiner, a device which effectively adds the signals and improves the apparent signal-to-noise ratio. The outputs of the diversity combiner (two at each site) plus the four basic output signals from the above receivers provide six possible sources of information. These are fed to the telemetry demodulation equipment where a manual selection is made of the signal to be demodulated. A spectrum analyzer is employed in selecting the best source of information obtained from the above equipment. These system refinements add greatly to the overall system reliability.

Selected data from the above equipment is routed to various displays for monitoring during the capsule pass, and the output of each receiver and diversity combiner is recorded for a permanent record. Approximately 20 quantities and notations, derived from the telemetry signals observed during the capsule transit, are incorporated into a standard format and transmitted by teletype to the Goddard Space Flight Center after the capsule has passed.

7.2.5 Capsule Communications System

See Figures 7-3 and 7-6 for a functional block diagram, and Figure 7-5 for the transmitter van floor plan.

Air-ground communications facilities at these sites use high-frequency (HF) and ultra-high-frequency (UHF) voice receiving and transmitting amplitude modulated (AM) equipment.

Equipment locations are indicated on area drawings for the sites.

Receiving antennas are mounted on steerable pedestals under control of the acquisition system, as described in paragraph 7.2.3.

The UHF signals are received on the same quad-helix antenna arrays used for telemetry signal reception. The HF signals are received by separate dipole antennas mounted on the same pedestals as the UHF antennas.

The UHF receiver outputs are fed to a diversity combiner where the signals are combined to add their output strength and minimize noise. The three output signals available are receiver #1, receiver #2, and the composite signal derived from the diversity combiner. These signals are then fed to the communications technician console HF-UHF selector switch. The best signal is selected and applied to the site intercom.

The HF receiver outputs are normally processed by a diversity relay actuator which automatically selects the stronger of the incoming signals. This signal is compared with the UHF signal at the communications technician console, where the better signal is selected for application to the flight controller air-ground receiving network. The HF receiver outputs also are brought directly to the communications technician console, bypassing the HF diversity relay actuator, where either receiver output can be selected as described above.

All voice communication with the capsule is recorded for future reference.

The transmitting antennas are mounted on a steerable antenna pedestal under direction of the acquisition system as described above. Both HF and UHF transmitters can be keyed (or operated) either individually or simultaneously.

7.2.6 Radar System

The Verlort radar supplies precise tracking data within its nominal range of 700 miles (Figure 7-7). After processing by conversion equipment, this data is sent by teletype to the Goddard Space Flight Center. In addition, this radar is used as a controlling source by the acquisition system for pointing the other antennas at the site, when the radar operator signifies, by a valid tracking signal, that the radar is effectively and accurately tracking the capsule. This function is explained in paragraph 7.2.3. See Figure 6-20 for a floor plan of the Verlort van.

The FPS-16 radar has a very narrow antenna beamwidth and is capable of providing very precise tracking data throughout its nominal 500-mile range. Data from this radar must also be converted to a teletype format for transmission by teletype to the Goddard Space Flight Center. This radar is also incorporated into the acquisition system, both as a directed and as a directing unit, as explained in paragraph 7.2.3.

7.2.7 Command Transmitting System

This system is provided at Hawaii to allow modification and correction of programmed events in the capsule by commands originating from the site. See Figures 7-3 and 7-8. The system does not have the abort feature found at Cape Canaveral and Bermuda, but can reset the timers in the capsule, which control the firing time of the retrorockets, thereby initiating capsule reentry into the atmosphere.

Commands originated at a control center console are processed by units called coder controllers and coders, respectively, into a form suitable for frequency modulating the system transmitters. Indications at the site control center verify that the desired signal has been transmitted. Telemetry indications are used to verify that the command signal has been received by the capsule, in that the desired response in the capsule alters one or more of the telemetered quantities received at the site.

Reliability of the system is increased by providing dual high-power (10-kw) and dual low-power (nominal 500-watt) transmitters at this site. A circuit is also provided to monitor normal operation of the system components. This circuit provides either an automatic switchover from the defective component to a spare unit or indicates abnormal functioning of the apparatus and the need for manual corrective action.

Two vans are provided for the system at this site (Figure 7-5). Each van contains a 10-kw power amplifier and a 500-watt (nominal) transmitter, both of which operate in the UHF band, and appropriate switching devices. The

10-kw unit in the master van is the primary transmitter. It is excited (or driven) by energy supplied from the FRW-2.

Switching facilities allow use of either the FRW-2 unit associated with the 10-kw unit in the same van, or the FRW-2 unit in the adjacent van, as the source of excitation. This flexibility allows a recombination of the system components to ensure maximum availability of high-power transmission. Figure 7-6 is a simplified schematic of the switching options available.

The FRW-2 units are utilized as command transmitters if the high-power facilities are in operative. There are, therefore, four transmitters available for use at this site.

Should the antenna at the air-ground van location become defective, a van can be moved from this area to an auxiliary hardstand (parking area) located in the telemetry and control area, where an antenna is made available for the command system.

NOTE

An emergency form of voice communication with the capsule is available at sites having command control transmitters. The command transmitter can be voice modulated for transmitting to the capsule, and the telemetry transmitter in the capsule can be keyed for ICW transmission to the site.

7.3 EQUIPMENT ALLOCATIONS

Table 7-1 lists major equipments at the sites.

7.4 EQUIPMENT LOCATIONS

Equipment locations appear in Figures 7-10 through 7-14.

7.5 SITE ADMINISTRATION

See Figure 7-15.

7.6 GEOGRAPHIC AND CLIMATIC DATA

Kauai is at the northern end of the Hawaiian Islands, approximately 100 miles northwest of Oahu (Figure 7-9). The island is the fourth largest of the group in size. Roughly circular in shape, it is approximately 555 square miles in area with a diameter of 32 miles. The island is mountainous with the highest peak reaching an elevation of approximately 5100 feet. Lowlands skirt the coast line except in the northwest, where the cliffs terminate at the water line. Paved roads exist only along the coast from Haena on the north to just past Manu on the west, and up to the Kokee mountain area on the west side of the island. The Kokee Road abuts the site location. This road is paved, medium-duty, and is a mountain road with many switchbacks, turns, and grades approaching 9 percent.

Site coordinates are latitude 22°07′ N, longitude 159°40′ W.

The annual average temperature at Kokee is 60°F. The lowest temperature recorded for this area was 27°F in January, 1931. Temperature ranges are:

	Maximum	*Minimum*	*Average*
Summer	87°F	60°F	77°
Winter	60°F	42°F	50°

Annual rainfall at the site area averages 60 to 80 inches, with the maximum rate of fall observed at 40 inches in 24 hours. The season of heavy rainfall is from November to February. Heavy storms average one per month in the winter. Storms such as hurricanes have averaged one every five years. The weather varies considerably in island areas away from the site. The nearby town of Kekaha averages 30 inches of rain per year, while 10 miles east of Kokee, the average rainfall approaches 500 inches per year.

The humidity in the station area averages 75 percent.

7.7 TRANSPORTATION AND COMMUNICATIONS

Commercial airline service is provided by the Aloha and Hawaiian Airlines, and by the Hawaiian Air Taxi Service from the commercial airport at Lihue. Connections beyond are made at Oahu. There is also a Naval Air Station auxiliary landing field, Barking Sands, which has two 6000-foot concrete runways. C-124 type planes have landed there. Lihue is 45 miles from the site, and Barking Sands is located approximately 26 miles from the site.

TABLE 7-1

EQUIPMENT ALLOCATIONS — KAUAI, HAWAII

System	*Equipment*	*Type or Model*	*Supplied By*
Acquisition	Active Acquisition Aid		Cubic
	Acquisition Data Console		Bendix Radio
Timing	Time Standard Rack		Bendix Radio
Radar	S-band	Verlort	Reeves (existing facilities)
	C-band	FPS-16	RCA (existing facilities)
Telemetry	Preamplifiers	PR-203	Nems-Clarke
	Receiver	1412	Nems-Clarke
	Receiver	1434	Nems-Clarke
	Diversity Combiner	DCA 500	Nems-Clarke
	Decommutators 90/90	TDS-90	Arnoux
	Decommutators 90/15	TDS-90	Arnoux
	Discriminators	TDA-102	Bendix
	Tape Recorder	FR-114	Ampex
Displays	Capsule Communicator		Bendix
	Aeromedical Observer		Bendix
	Capsule Observer		Bendix
Capsule Command	Transmitter (10-kw)	240 D-2	Collins-Alpha
Transmitting System	Transmitter (500-watts)	AN/FRW-2	Collins-Alpha
	Command Coder Multiplex Remoting System	Type 230 Model 1	Northern Radio
	Coder	KY-171	Collins-Alpha
	Coder Controller	C 1669/URW	Collins-Alpha
Air-Ground Communications	HF Transmitter	CS-2029	Gates
	Microphone Amplifier	M-5167	Gates
	Communications Technician Console	BXR-CTC-500	Bendix Radio
	HF Receiver	R390A/URR	Collins
	UHF Transmitter	GRT-3	Radio Receptor
	UHF Receiver	R278B/GR	Collins

There is no rail service on Kauai Island.

Ships dock at Port Allen and Nawiliwili, and are operated by Matson, States Marine, and Inter-Island Lines. Matson Line ships stop at both Kauai ports approximately every two weeks.

Passenger cars require approximately 40 minutes to traverse the road from Kekaha to the site, a distance of 16 miles. The station transportation is supplied by a three-vehicle complement, but an automobile is essential for permanent residents. Rental cars and taxi services are available. There is no bus transportation on the island.

NOTE

Current gasoline prices are 41¢ per gallon.

The Hawaiian Telephone Co. provides local and long distance telephone service.

7.8 SITE PERSONNEL FACILITIES AND SERVICES

Site personnel live in offsite housing. Rental housing is available in the larger communities on the island. Living quarters are obtained for the most part through local inquiries, as rental units are not generally advertised. At the time of this writing there are about 200 hotel rental units on the island. Most of these units are located on the eastern side of the island. Temporary quarters close to the site, consisting of cottage-type accommodations, are available. Resort-type hotels are relatively expensive during the tourist season. Rates are $5.00 to $10.00 single, $7.50 to $18.00 double. For personnel permanently assigned to the area a few single dwellings, mostly of the 1930-1940 vintage, are for rent, with the rentals averaging $60 to $80 per month for two-bedroom homes. New three-bedroom houses are selling for $12,000-$13,000 in the area. Housekeeping units are available at Kokee Camp, but these are of semi-permanent nature.

Living costs are somewhat higher than on the United States mainland. Food prices are 20 percent higher than in California; clothing and other prices are approximately 5 percent higher than in California, due to the additional freight costs for household goods brought here from the mainland.

Eating places are not convenient to the site. Operating personnel are required to bring their own lunch. Equipment, such as a hotplate, refrigerator, and coffee maker, is necessary at the site.

Medical facilities are adequate on the island. Dental, medical, and hospital facilities are available in Waimea, and hospital facilities are available in Lihue and Kapaa. No special precautions are required in the area, but protection should be provided against sunburn.

Recreation facilities in the area include fishing, swimming, tennis, golf, bowling, and movies. Television sets are useful only on the eastern side of the island, where four channels can be received. Electrical supply is 115-volt, 60-cycle alternating current, suitable for appliances used on the mainland. There is one weekly newspaper, but four public libraries located in Lihue, Hanapepe, Waimea, and Kapaa are well equipped for supplementary reading.

Mail service to New York from Honolulu requires 10 days by regular channels, or 1½ days by airmail.

About 50 churches, mostly in the Lihue-Waimea area provide religious services. Major denominations represented include Adventist, Assembly of God, Baptist, Catholic, Congregational, Episcopal, Latter-Day Saints, Lutheran, Methodist, Missionary, and Nazarene.

The temperature extremes listed in paragraph 7.6 indicate that a variety of clothing is necessary, including raincoats and head protection from the sun. The high humidity of the area can cause discomfort during the hotter months, and well-ventilated clothing is most useful at this time.

7.9 MISCELLANEOUS INFORMATION

Desirable immunization measures are listed in Figure 1-4 along with other requirements for a visit to the island.

Sufficient information on banking services is not available at this writing. It is suggested that the Chamber of Commerce in Lihue be contacted for this information. Their telephone number is 64-583.

NOTE

All specific information and costs are necessarily subject to change and should be verified against change with the passing of time.

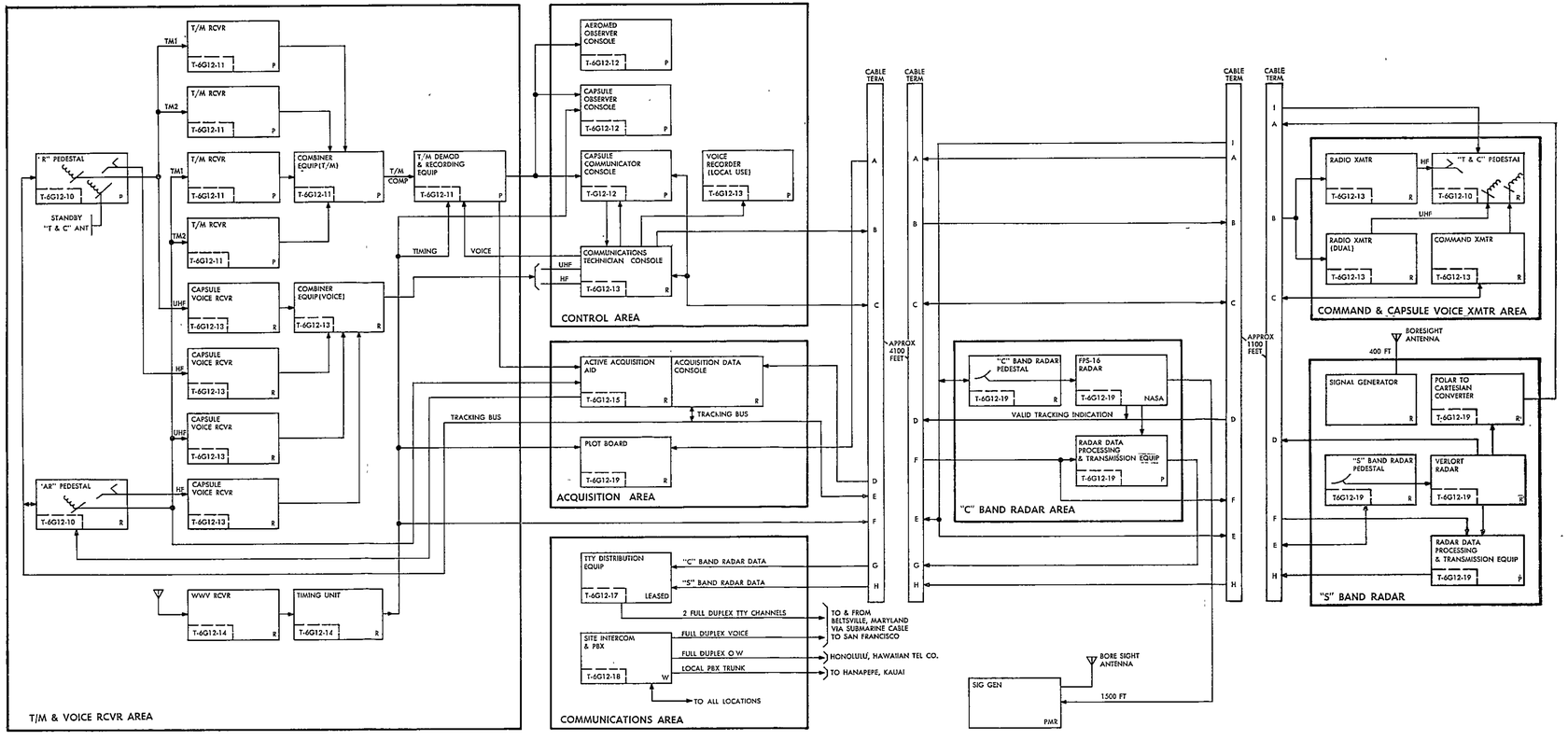


FIGURE 7-1. MASTER FUNCTIONAL BLOCK DIAGRAM—HAWAII

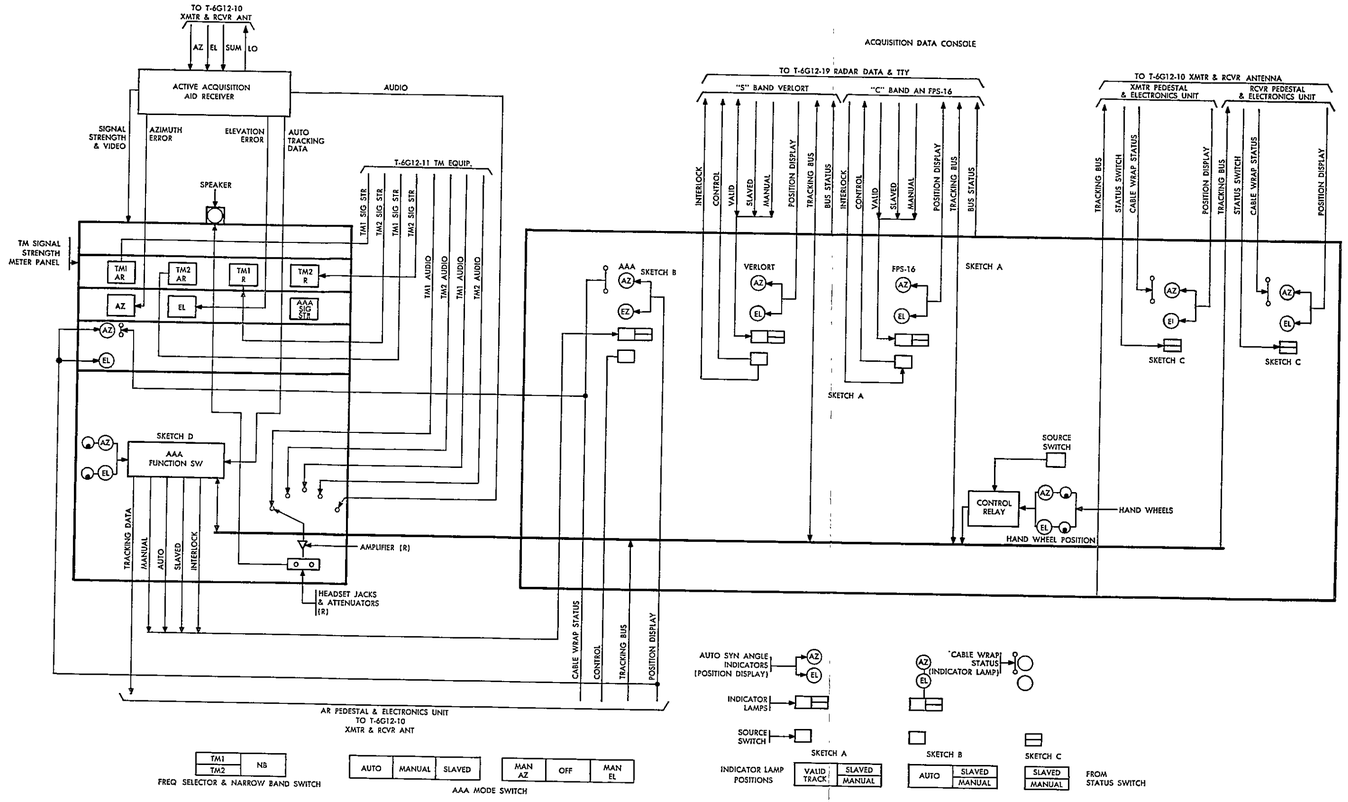


FIGURE 7-2. FUNCTIONAL BLOCK DIAGRAM, ACQUISITION SYSTEM—HAWAII

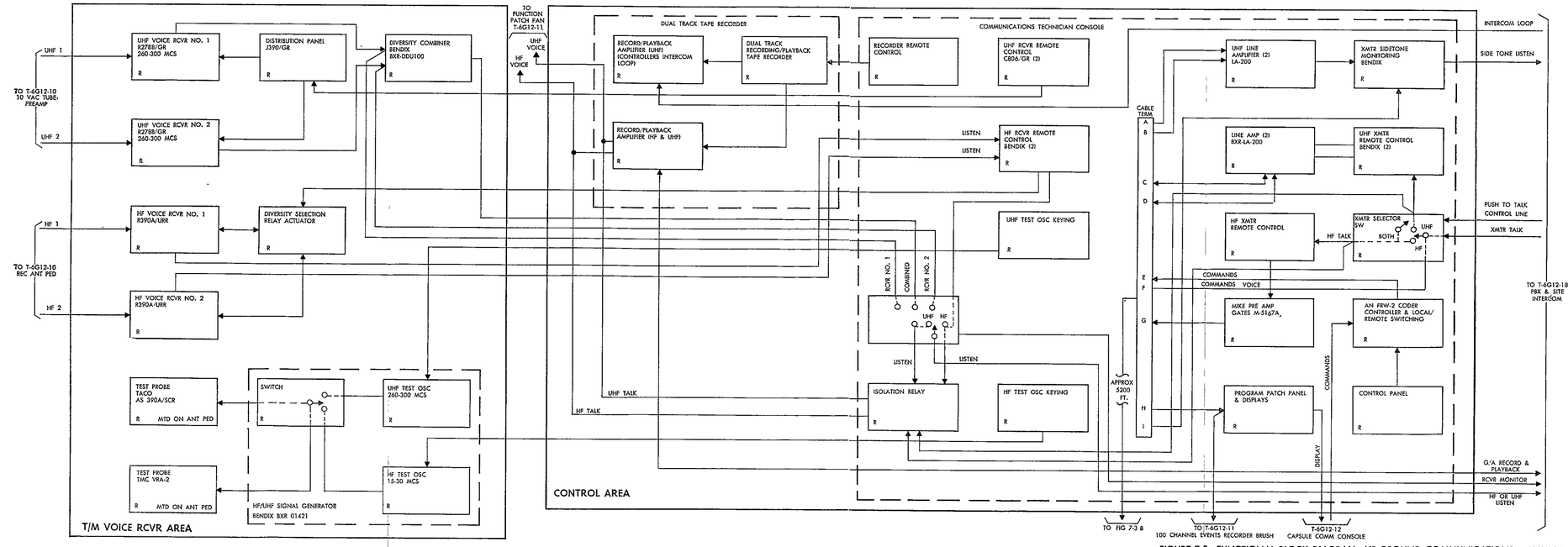


FIGURE 7-3. FUNCTIONAL BLOCK DIAGRAM, AIR-GROUND COMMUNICATIONS — HAWAII

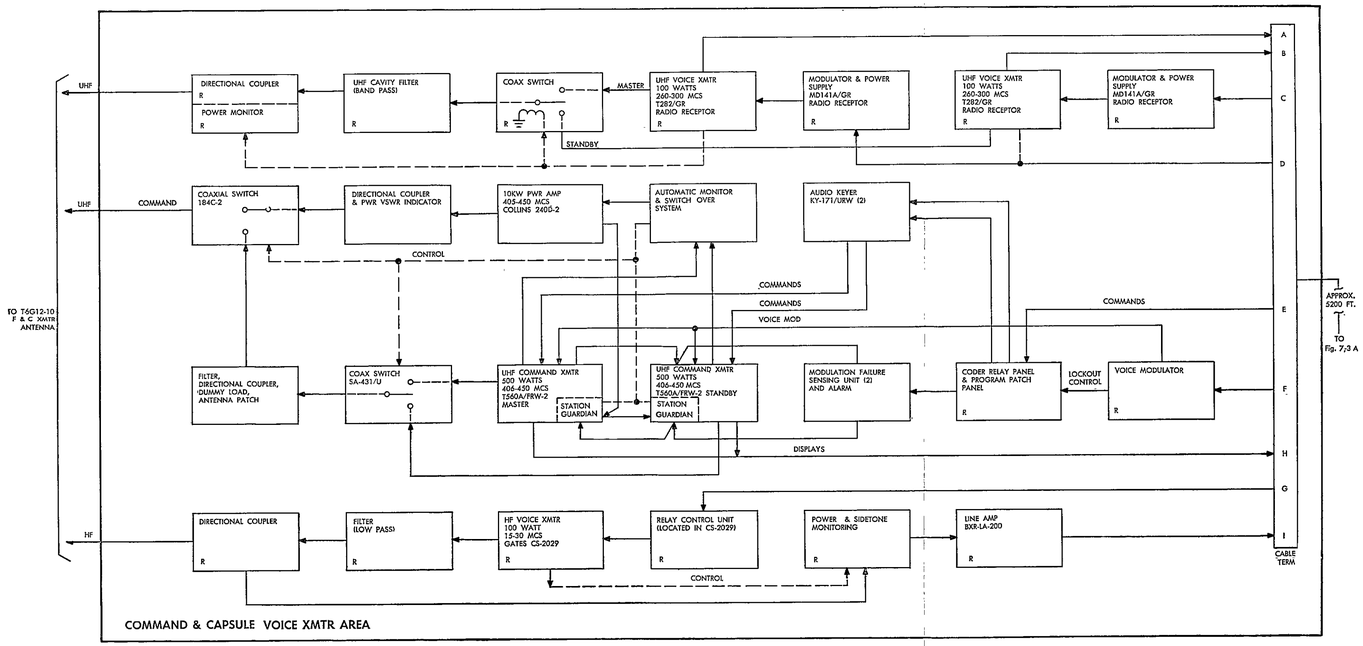


FIGURE 7-5. FUNCTIONAL BLOCK DIAGRAM, AIR-GROUND COMMUNICATIONS — HAWAII (Continued)

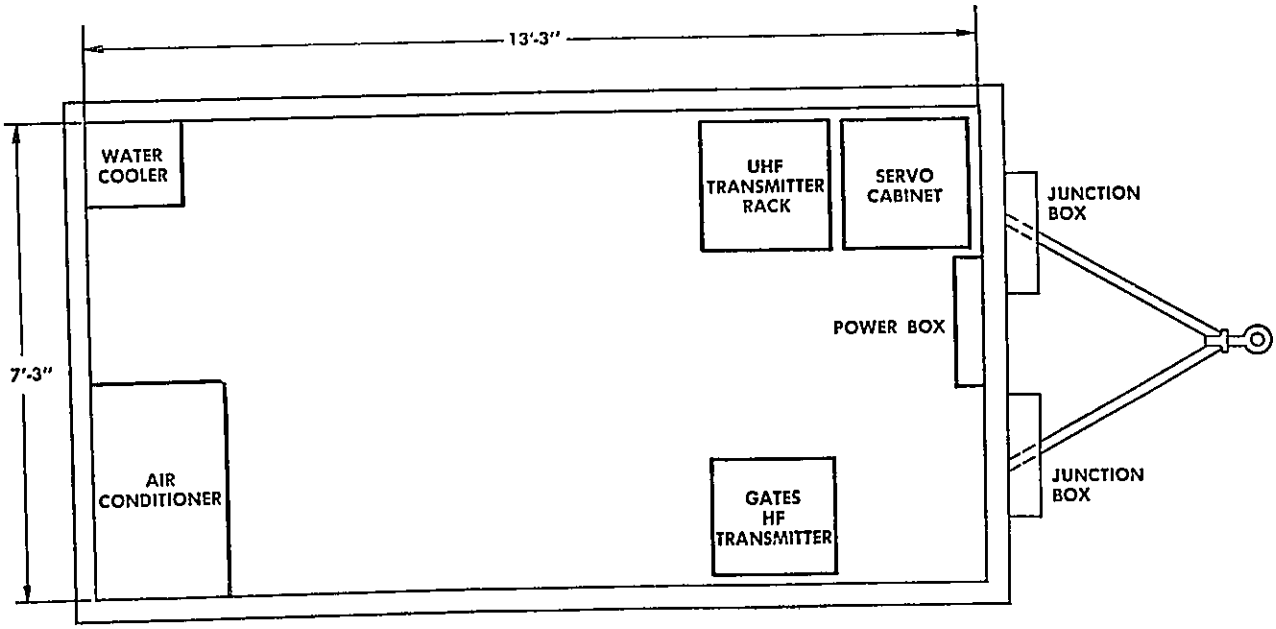


FIGURE 7-4. TRANSMITTER VAN — HAWAII; ZANZIBAR; CANTON ISLAND; KANO, NIGERIA

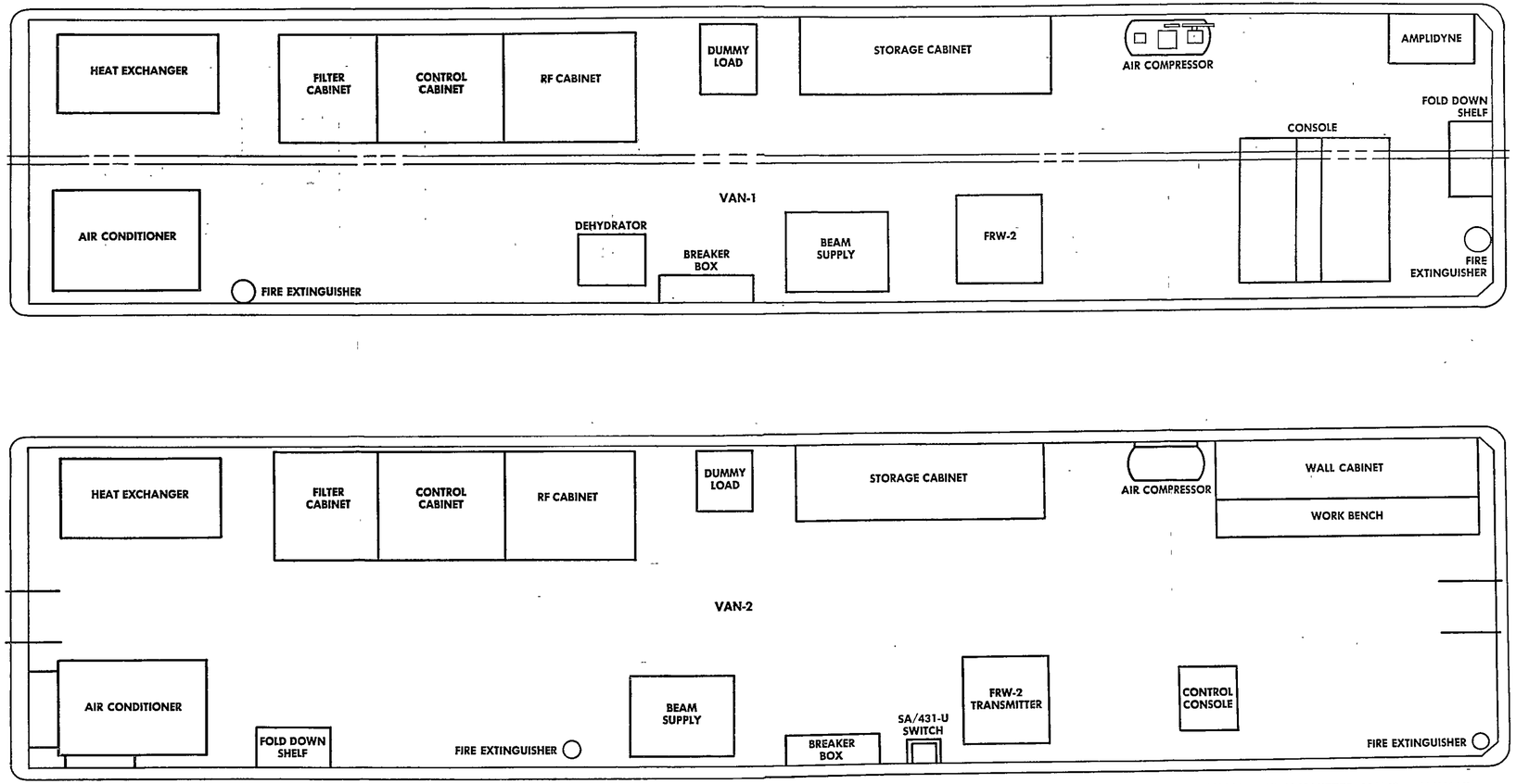


FIGURE 7-5. FLOOR PLAN, UHF COMMAND TRANSMITTER VANS—HAWAII

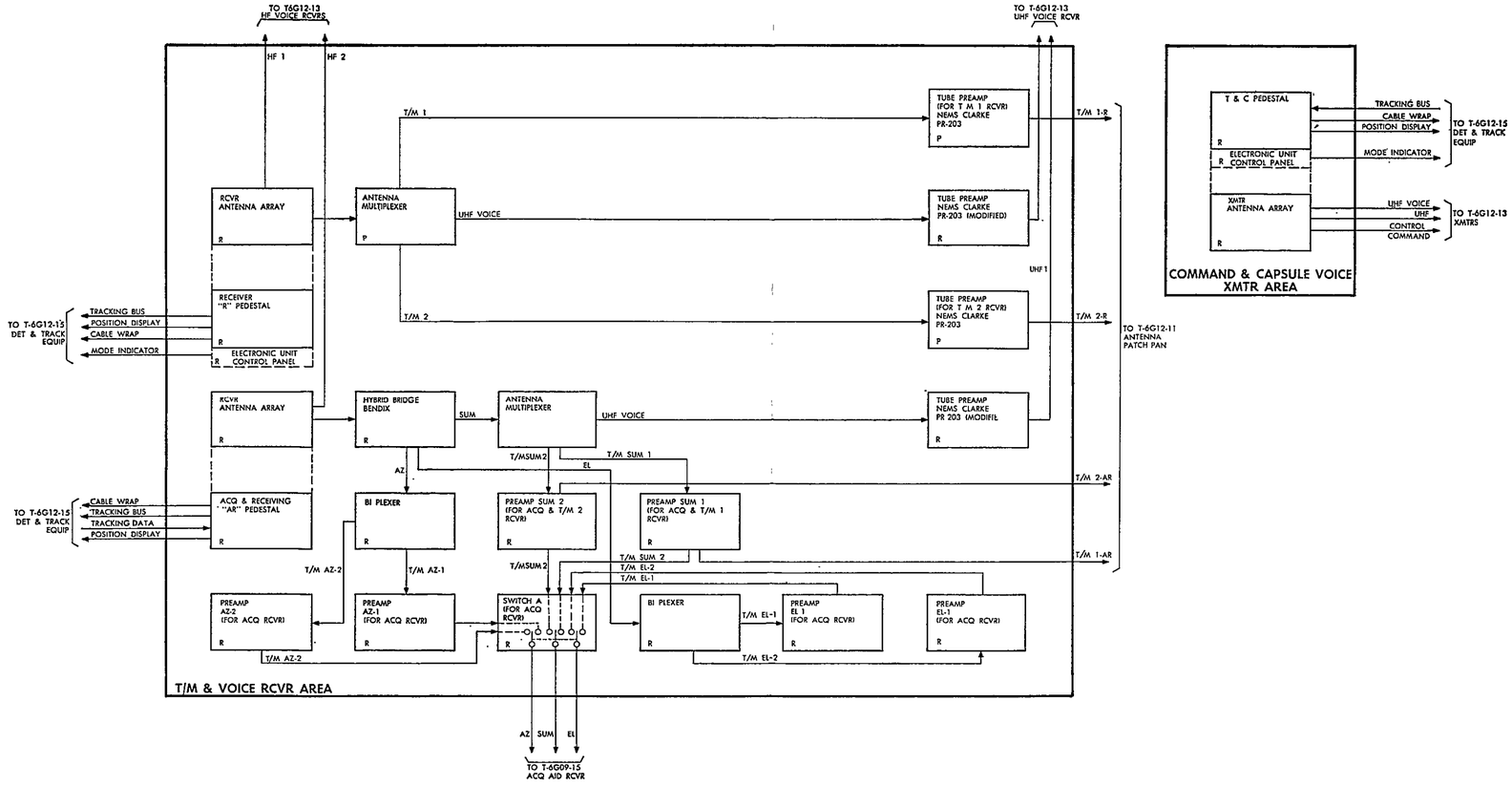


FIGURE 7-6. FUNCTIONAL BLOCK DIAGRAM, ANTENNA SYSTEM—HAWAII

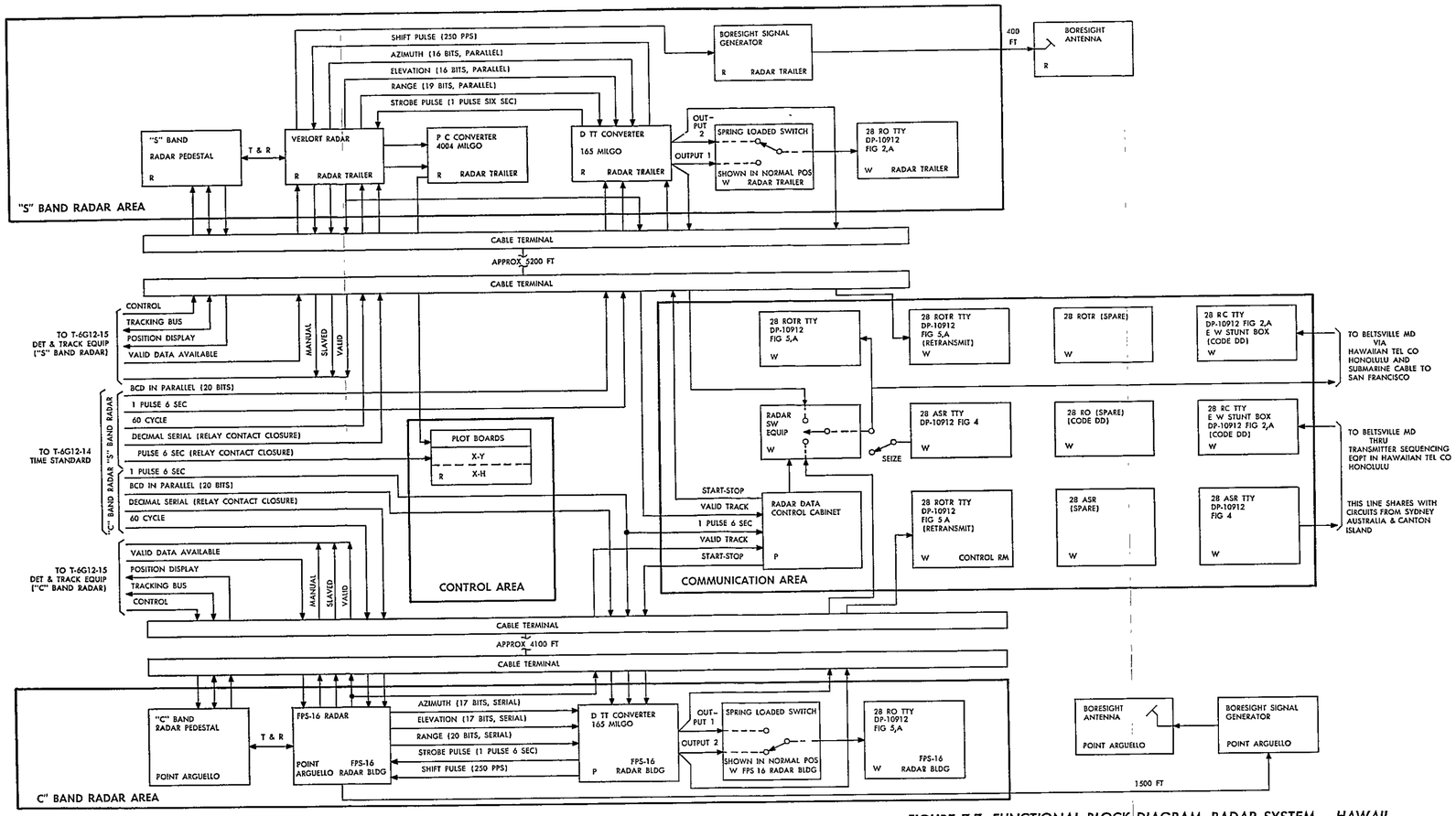
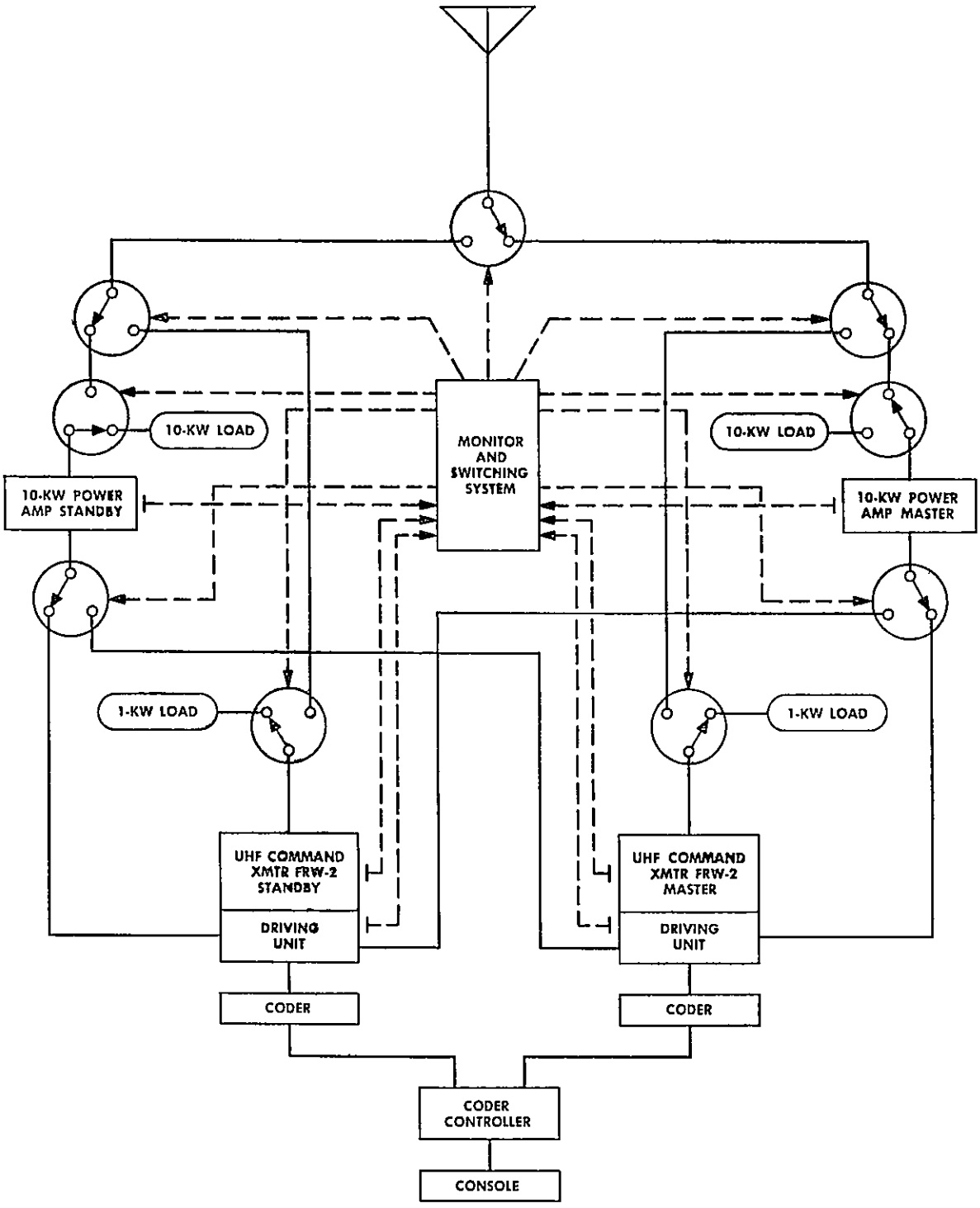


FIGURE 7-7. FUNCTIONAL BLOCK DIAGRAM, RADAR SYSTEM—HAWAII



NOTE:
DASHED LINES INDICATE
MONITORING AND SWITCHING

FIGURE 7-8 COMMAND TRANSMITTER SYSTEM—HAWAII

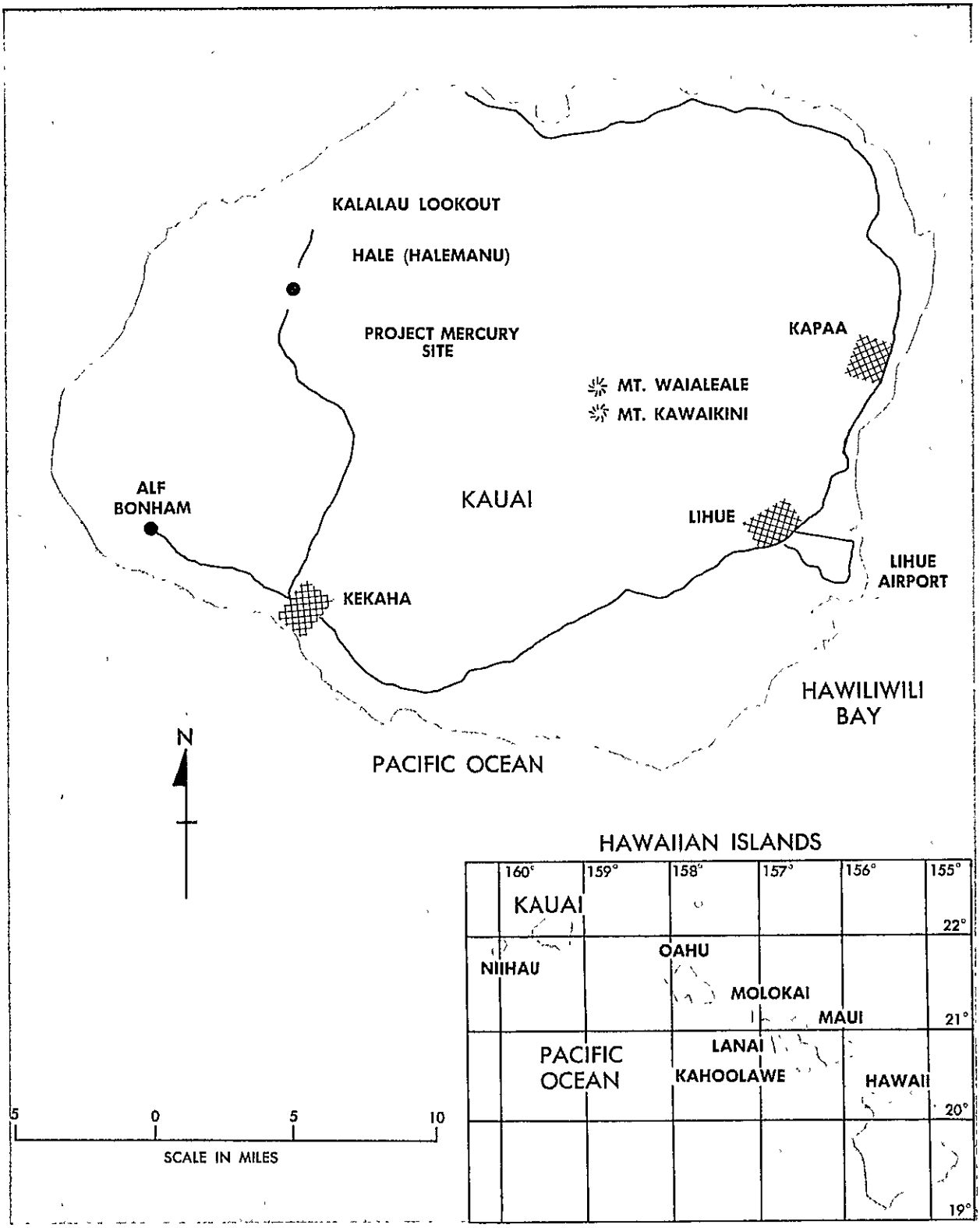


FIGURE 7-9. AREA MAP — HAWAII

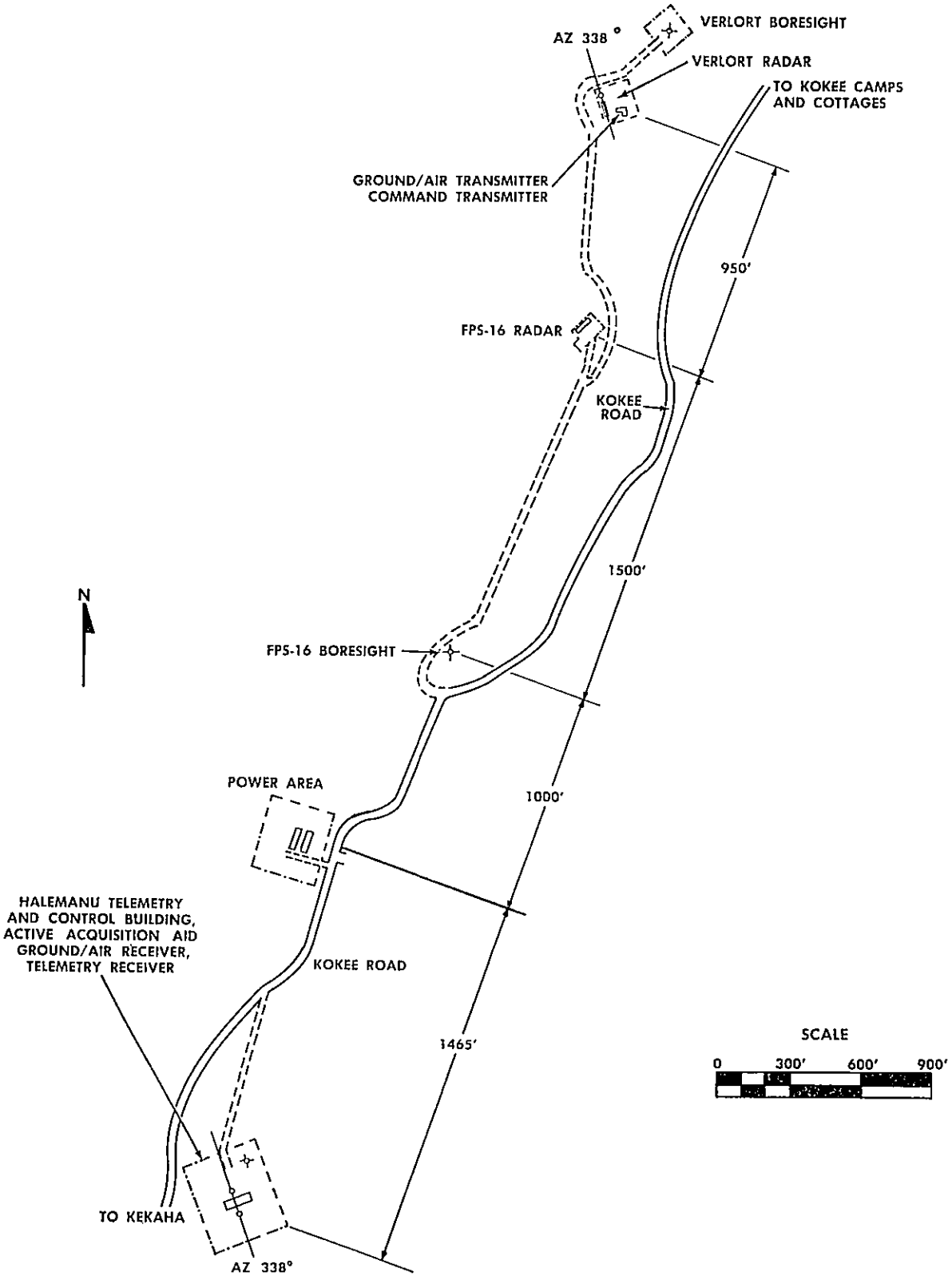


FIGURE 7-10. PROJECT MERCURY — HAWAII

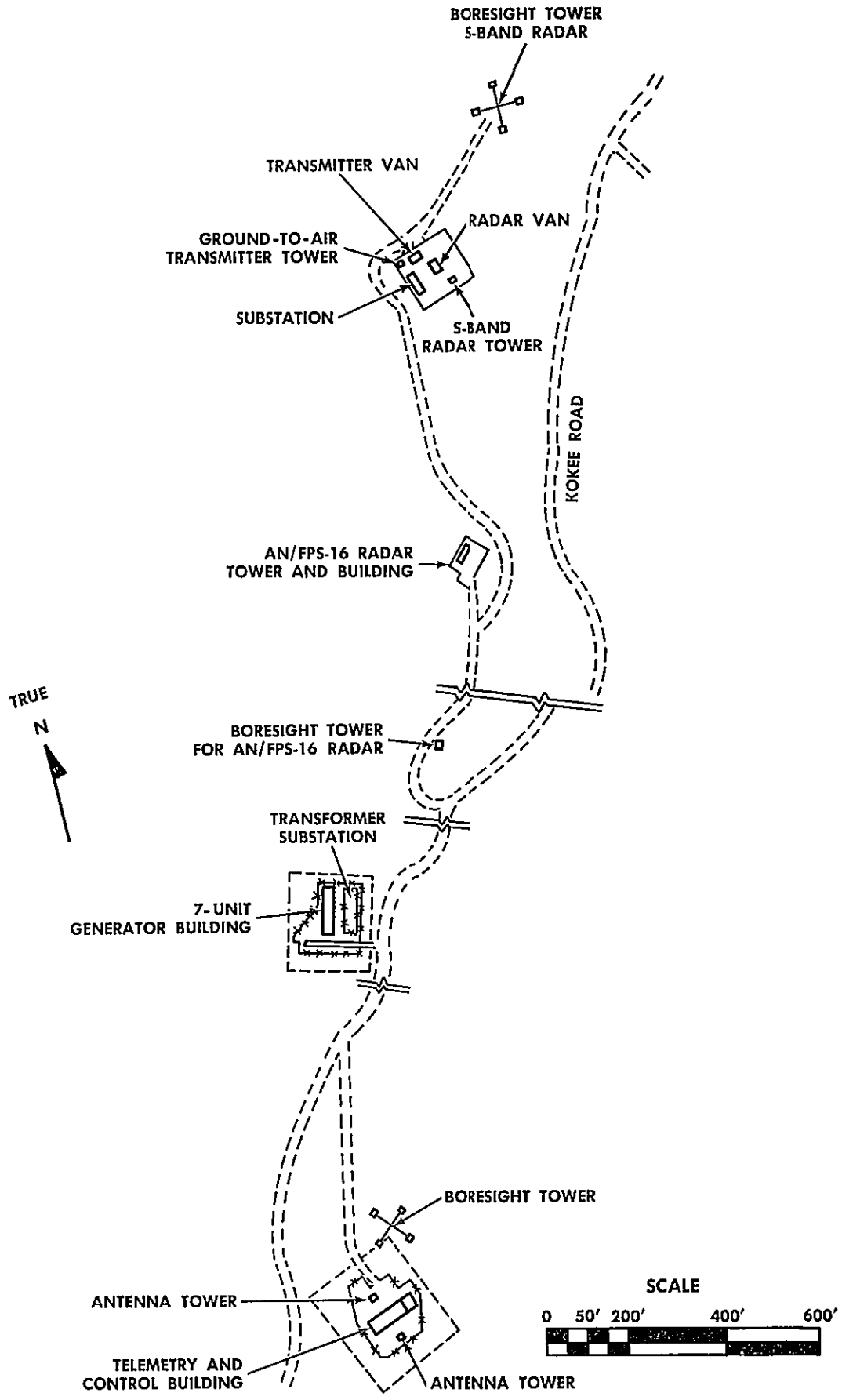


FIGURE 7-11. LOCATION MAP — HAWAII

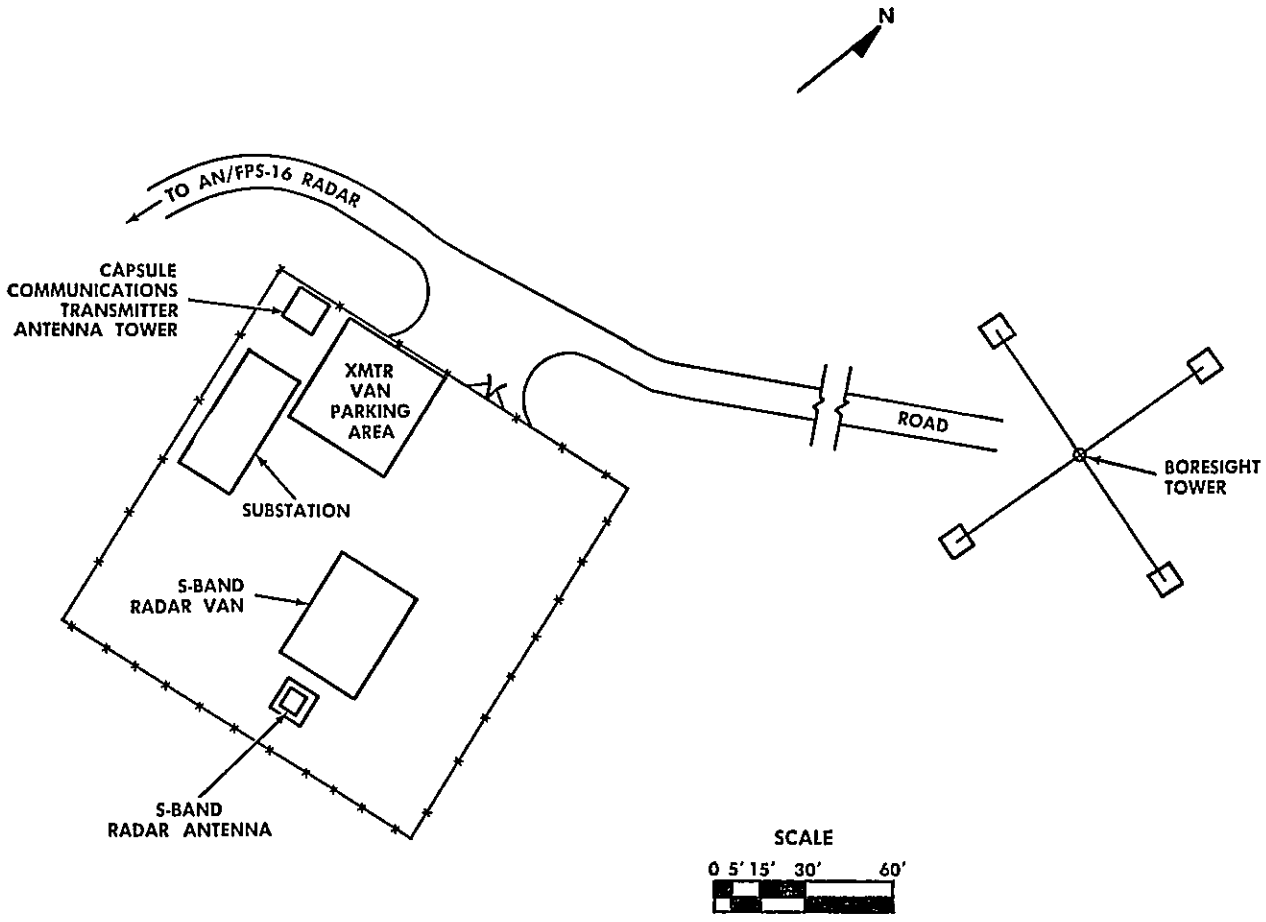


FIGURE 7-12. SITE PLAN, S-BAND RADAR AREA—HAWAII

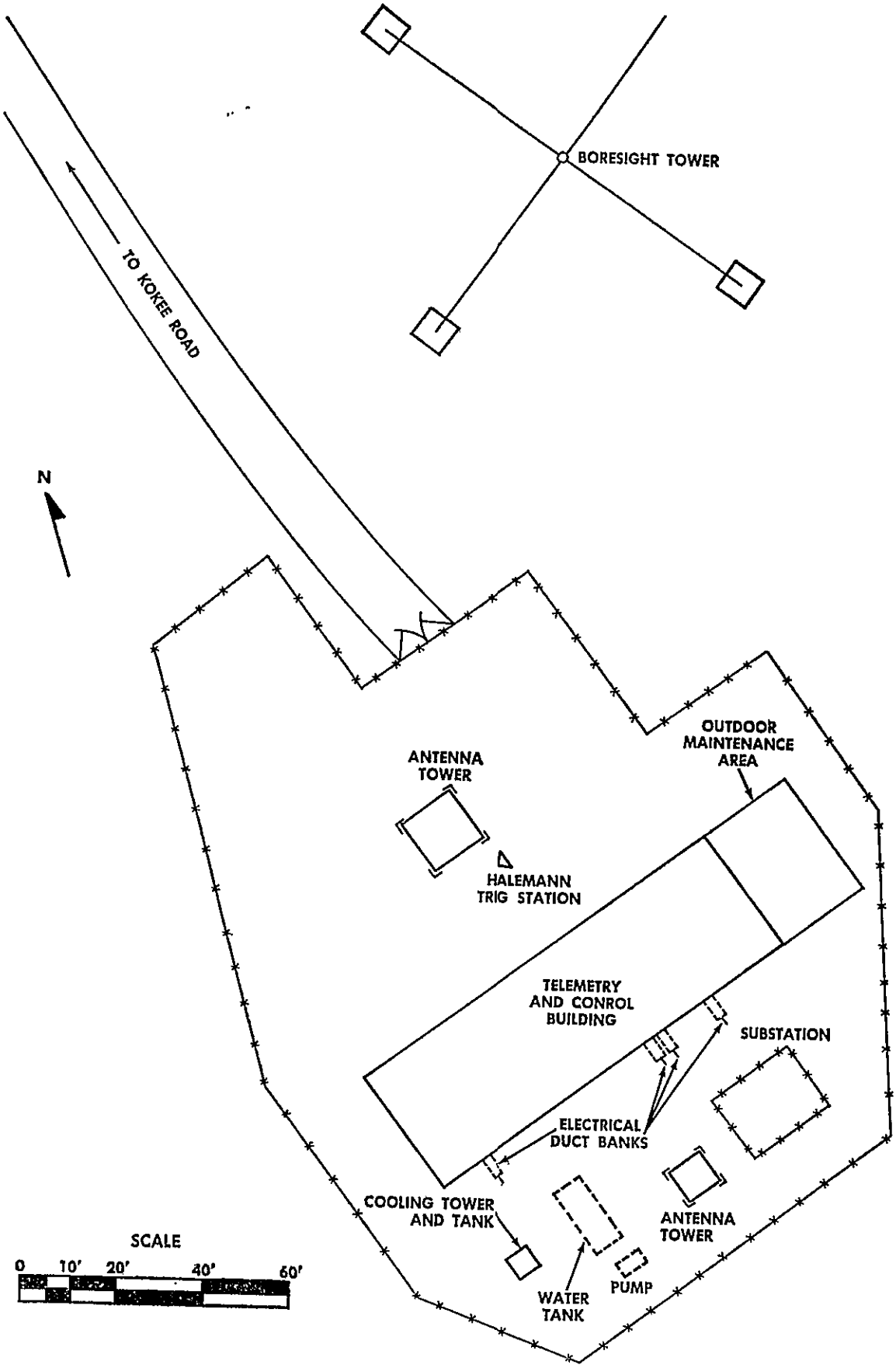
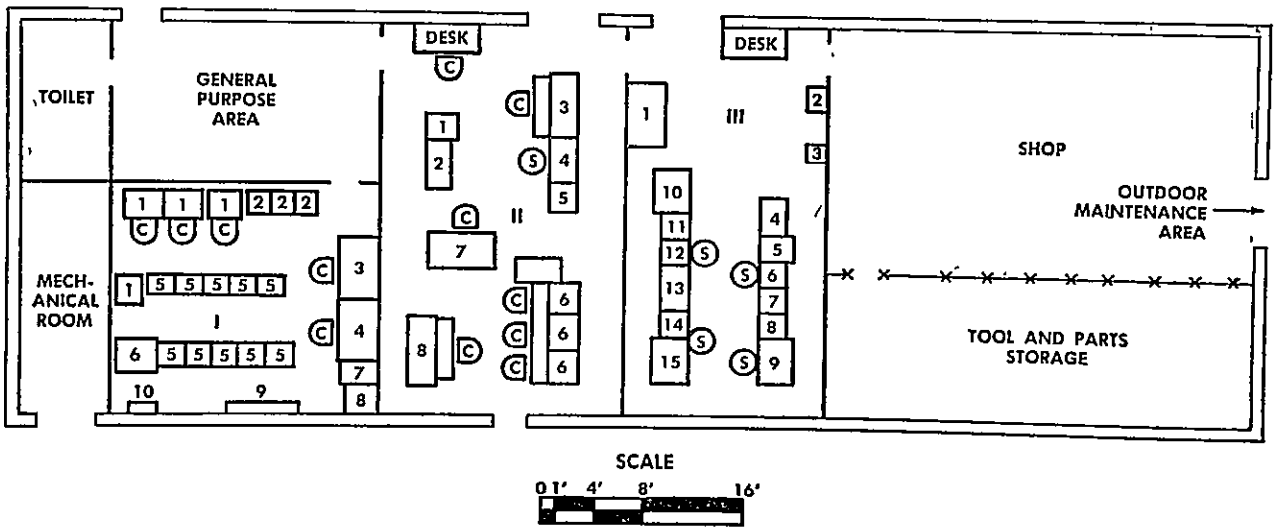


FIGURE 7-13. SITE PLAN, TELEMETRY AND CONTROL AREA — HAWAII



AREA I

1. 28ASR
2. 28RO
3. DESK
4. WORK TABLE
5. 112 KEY EQUIPMENT
6. 28ROTR
7. FILE
8. STORAGE CABINET
9. DISTRIBUTING FRAME
10. POWER DISTRIBUTION PANEL

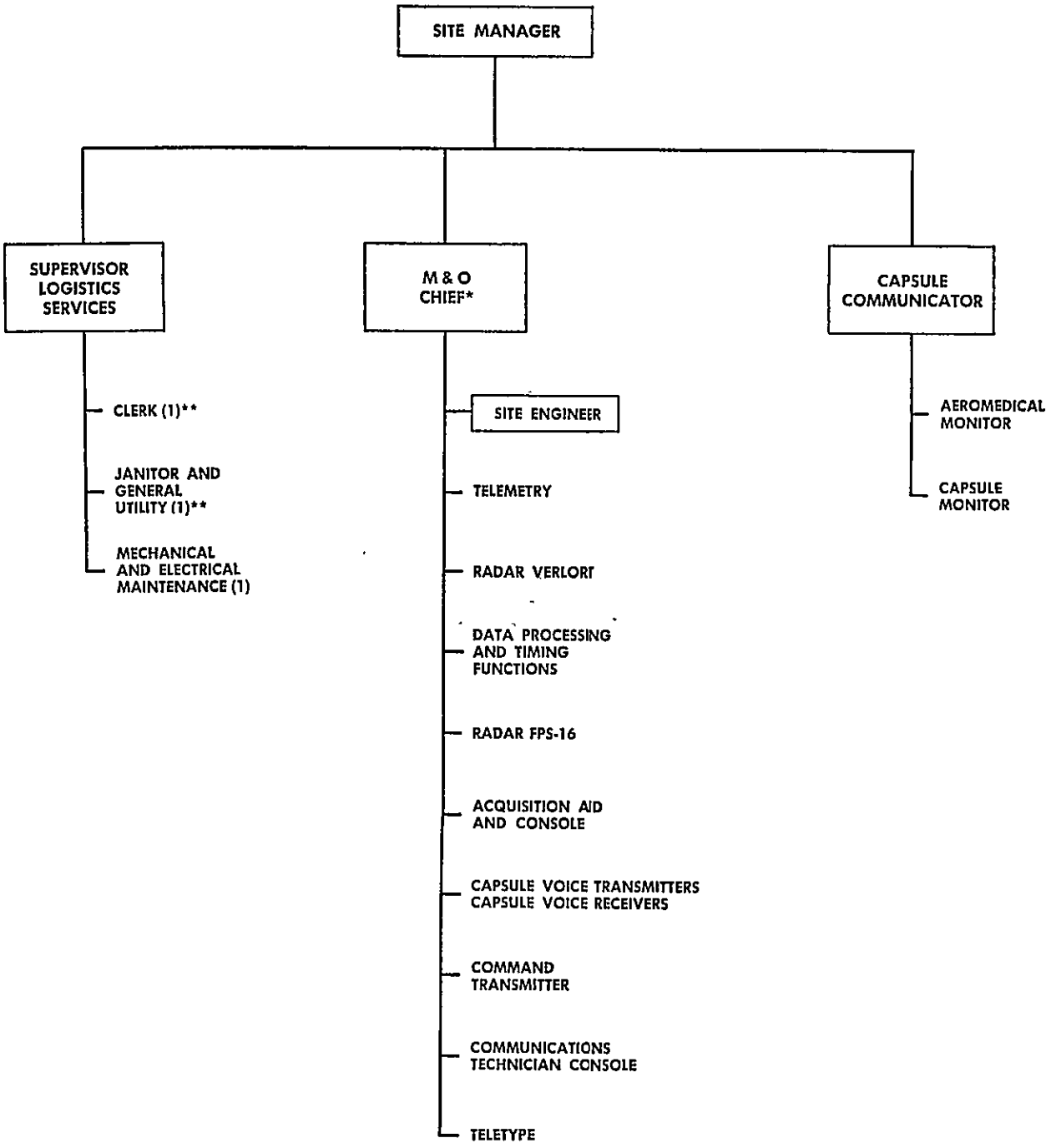
AREA II

1. POLAR-CARTESIAN CONVERTER
2. PLOT BOARD
3. ACQUISITION DATA CONSOLE
4. ACQUISITION AID EQUIPMENT
5. SERVO
6. COMMAND STATION DISPLAYS
7. M & O SUPERVISOR DESK
8. COMMUNICATIONS TECHNICIAN CONSOLE

AREA III

1. WORK BENCH
2. POWER PANEL
3. LIGHT PANEL
4. TIMING STANDARD
5. DECOM MONITOR
6. 90-90 DECOM
7. 90-15 DECOM
8. RECORDER
9. PEN RECORDERS
10. VOICE RECEIVERS
11. DISCRIMINATORS
12. CALIBRATOR
13. RECEIVERS
14. CONTROL
15. RECORDERS

FIGURE 7-14. FLOOR PLAN, TELEMETRY AND CONTROL AREA — HAWAII



*OPERATES TECHNICIANS INTERCOM POSITION
**DURING FLIGHT OR DRILL, ASSISTS IN MESSENGER SERVICE AND MONITORS RECEIVE-ONLY TELETYPE EQUIPMENT

FIGURE 7-15. SITE ADMINISTRATION — HAWAII

Section 8

POINT ARGUELLO

TABLE OF CONTENTS

Paragraph		*Page*
8.1	Purpose of the Site	8-1
8.2	Systems	8-1
	Ground Communications System	8-1
	Timing System	8-1
	Acquisition System	8-1
	Telemetry System	8-1
	Capsule Communications System	8-3
	Radar System	8-4
	Command Transmitting System	8-4
8.3	Equipment Allocations	8-5
8.4	Equipment Locations	8-5
8.5	Site Administration	8-5
8.6	Geographic and Climatic Data	8-5
8.7	Transportation and Communications	8-7
8.8	Site Personnel Facilities and Service (Housing, Medical Facilities, Recreational Facilities, Mail Service, Religious Facilities, Clothing, and Food)	8-7
8.9	Miscellaneous Information (Money and Taxes)	8-7

LIST OF ILLUSTRATIONS

Figure	*Title*	*Page*
8-1	Master Functional Block Diagram —Point Arguello	8-9
8-2	Functional Block Diagram, Timing System—Point Arguello	8-10
8-3	Functional Block Diagram, Acquisition System—Point Arguello	8-11
8-4	Functional Block Diagram, Telemetry System—Point Arguello	8-12/13
8-5	Functional Block Diagram, Capsule Communications System — Point Arguello	8-14/15
8-6	Functional Block Diagram, Radar System—Point Arguello	8-16
8-7	Capsule Command Transmitter System—Point Arguello	8-17
8-8	Area Map—Point Arguello	8-18
8-9	Site Location—Point Arguello	8-19
8-10	Transmitter Building—Point Arguello	8-20
8-11	Floor Plan, UHF Command Transmitter Vans—Point Arguello	8-21
8-12	Room 224, Range Operations Building—Point Arguello	8-23
8-13	LA-24 Building, Acquisition Aid Equipment—Point Arguello	8-24
8-14	Equipment Location, Range Operations Building—Point Arguello	8-25
8-15	Equipment Location, Telemetry Building—Point Arguello	8-26
8-16	Verlort Radar Van—Point Arguello	8-27
8-17	Site Administration—Point Arguello	8-28

LIST OF TABLES

Table	*Title*	*Page*
8-1	Equipment Allocations — Point Arguello	8-6

SECTION 8. POINT ARGUELLO, CALIFORNIA

8.1 PURPOSE OF THE SITE

In addition to the functions and systems noted in Figure 1-1, this site is important to Project Mercury because it is a backup to the Kauai Island command transmitter installation to ensure accurately timed firing of the capsule retrorockets, should the resetting of the capsule timer by Kauai be impossible. Accurately timed firing of these rockets is necessary to cause the capsule to land in the desired recovery area.

8.2 SYSTEMS

Figure 8-1 is a system functional block diagram of this site.

8.2.1 Ground Communications System

Figure 1-3 illustrates the world-wide network of Project Mercury which is used to communicate with the Goddard communications and computing center and the Mercury Control Center at Cape Canaveral. Figure 1-2 is a typical intrasite communications network which illustrates the setup for this site.

The primary communications facilities from Point Arguello are by facilities leased from American Telephone and Telegraph.

8.2.2 Timing System

The timing system provides time correlation of data collected from radar and telemetry systems, and it provides a driving source for the control area time displays (Figure 8-2). The time reference used is that of Greenwich Mean Time (GMT) expressed in hours, minutes, and seconds.

Time signals broadcast from the Bureau of Standards radio station WWV are received at the site on receivers provided for this specific purpose. These signals are used as a reference standard against which a stable one-megacycle oscillator is compared and adjusted. Successive frequency division circuits supply frequencies from 1 kc to one cycle per minute. During this procedure, adjustments are made as necessary to synchronize the frequency of the locally generated signal with the frequency of the received signal. A check of the system is provided by a visual comparsion on an oscilloscope of the one-pulse-per-second output of the timing system and the once-per-second tone burst of WWV.

Important outputs of this system are as follows.

a. An output representing the GMT in hours, minutes, and seconds, is used in the data processing and data conversion equipment to time-tag the radar data, and to drive certain time displays.

b. A pulse from the timing equipment every six seconds causes radar data to be read out.

c. Telemetry data is time-tagged for teletype transmission. Time reference is GMT, which is delivered in the serial form of a ten-pulse-per-second pulse train.

8.2.3 Acquisition System

An acquisition system is provided at Point Arguello to assist in orienting the antennas for the radar, command, telemetry, and capsule communications radio systems (Figure 8-3).

Two types of consoles are provided for system operation at this site.

a. The *active acquisition aid control console* controls the operation of the active acquisition aid which is essentially an antenna pointing device. Manual, automatic, or slaved operation of the acquisition aid antenna is controlled by this console. These types of operation are defined as follows.

(1) Manual operation is the control of antenna position with handwheels located on the console. Visual indications are provided to show the azimuth and elevation coordinates selected with handwheel operation.

(2) Automatic operation is the control of antenna position by the active acquisition aid receiver without manual assistance. The control is accomplished by the directional-sensing capabilities of a quad-helix antenna array (on the A-pedestal), associated hybrid and acquisition receiver. A telemetry signal after process-

ing through this equipment is converted into positioning voltages for pointing the A-pedestal toward the capsule.

(3) Slaved operation is control of the acquisition aid antenna by positional data supplied by the antennas of other systems at the site.

Signal strength meters provided on this console aid selection for tracking purposes of the stronger of two telemetry frequencies transmitted by the capsule. The strength of the signal received through the acquisition aid receiver is also indicated by a signal strength meter. Error voltages which indicate the correction voltages currently applied to the acquisition aid antenna pedestal are displayed on this console.

b. The *acquisition data console* monitors the control mode (manual, automatic, or slaved) and the azimuth and elevation of the various steerable antennas at the site. The acquisition data console allows any of the steerable antennas at the site to be slaved to the source furnishing the most accurate tracking information.

Since the acquisition aid antenna receiving pattern has a 20-degree beamwidth, the active acquisition aid is capable of acquiring the target early and furnishing refined capsule position information to all other steerable antenna pedestals at the site. Since the area to be searched has been greatly decreased, radar equipments with beamwidths of less than 3 degrees may now acquire the target more readily.

An acquisition aid console and acquisition data console are located in the LA-24 Optical Building (Figures 8-9 and 8-13). An acquisition data console is also located in the Telemetry Building (Figures 8-9 and 8-15). These consoles are relatively close to systems associated with them, but distant from each other. For this reason, synchro remoting circuits are added to the circuits between consoles to minimize transmission losses. Synchro remoting equipment is also added to the control leads associated with the transmitting antenna pedestal from the acquisition data console located in the receiver area location.

Signals or displays associated with systems or equipments appearing on the acquisition system consoles are as follows.

a. LA-24 Building.

(1) Active Acquisition Aid Control Console.

(a) From the telemetry system: Frequencies TM1 and TM2 to console for signal strength metering and signal selection.

(b) Cablewrap indications (for the A-pedestal): Two lamps, one of which is lit when the antenna is left of center, and the other, when the antenna is right of center.

(c) From the active acquisition aid receiver: Error voltage, and signal strength (sum of error voltages) voltage.

(2) Acquisition Data Console.

(a) From the active acquisition aid console: Azimuth, elevation, and control mode.

(b) From the Verlort radar: Azimuth, elevation, and control mode.

(c) From the FPS-16 radar: Azimuth, elevation, and control mode.

(d) From the telemetry area acquisition data console: Azimuth, elevation, and control mode.

b. Telemetry Building.

(1) Acquisition Data Console.

(a) From the R1 antenna pedestal: Frequencies TM1 and TM2 to the console for signal strength metering and signal selection.

(b) Cablewrap status of the R1 pedestal.

(c) From the R2 antenna pedestal: Frequencies TM1 and TM2 to the console for signal strength metering and signal selection.

(d) Cablewrap status of the R2 antenna pedestal.

(e) From the T&C antenna pedestal: Cablewrap, azimuth, elevation, and control mode.

(f) From the acquisition data console (at LA-24 Building): Azimuth, elevation, and valid data indication.

8.2.4 Telemetry System

This system monitors the physical condition and the capsule environmental conditions dur-

ing flight (Figure 8-4). Pulse rate, body temperature, cabin pressure, and vibration are but a few of the many items of information transmitted from the capsule over the telemetry system. Sensors in the capsule supply an output (analog) voltage which is used to modulate the telemetry carriers of two capsule transmitters, each operating on a different frequency in the 225-260 megacycle (mc) band.

Four receivers are used with two quad-helix antenna arrays on separate pedestals positioned to obtain both height and space diversity. These receivers, located in the Telemetry Building, are arranged in pairs, with each pair tuned to one of the two transmitter frequencies. The receiver outputs are fed to a diversity combiner complex which effectively adds the signals and improves the apparent signal-to-noise ratio. A spectrum analyzer is used to select the best source of information obtained by the above system refinements.

Outputs of all four receivers, together with those of the diversity combiners, are sent over lines (capable of passing 12 kc) to the Range Operations Building where the signals are demodulated and separated.

A signal strength composite is also transmitted to the Range Operations Building. This signal is derived from the four receiver signal strength outputs.

Capsule telemetry signals received by a high-gain antenna and receiving equipment located on San Nicolas Island are delivered as two telemetry composite outputs (of diversity combiners) by a microwave communications system to Mercury demodulation equipment in the Range Operations Building. Mercury switching and patching facilities, provided in the Range Operations Building, permit monitoring and selection of the signals from San Nicolas Island decommutation and data display. Existing equipment at San Nicolas Island (including Nems-Clarke 1432 Receivers and DDU-1000 diversity combiners) is utilized.

The demodulation and separation equipment for the system is located in the basement equipment area (Room 107) of the Range Operations Building. Three of the four channels used in transmitting telemetry information (and used for cardiogram and respiration signals) are sent directly from the discriminators to appropriate displays. The fourth channel discriminator output is decommutated into individual analog and events signals for display and recording.

These options greatly increase system reliability over that of a straightforward system.

Recording equipment (Ampex FR-107A) is used at the Telemetry Building to record receiver composite outputs. An eight-channel pen recorder is used to record the signal strengths of the four receivers.

National Aeronautics and Space Administration recording equipment (Ampex FR-114) and recording oscillographs are located in the Range Operations Building.

Approximately 20 quantities and notations are prepared in a standard summary format from telemetry signals observed during capsule transit. This summary is transmitted by teletype to the Mercury Control Center immediately after the capsule has passed.

8.2.5 Capsule Communications System

The basic function of the air-to-ground (and ground-to-air) voice transmission system is to deliver intelligible voice signals to the Astronaut during the period of each orbit when the capsule is within range (Figure 8-5). The voice transmission system is used to convey instructions to the Astronaut, request information, and answer questions. Two amplitude modulated (AM) systems are used for this purpose. These systems operate in the high-frequency (HF) and ultra-high-frequency (UHF) bands, respectively, and provide direct communications between the capsule and the flight controller positions. To ensure reliable transmission and reception, these equipments are operated simultaneously.

NOTE

In addition to the above systems, emergency communications with the capsule are possible. The command transmitter can be voice modulated for transmission from the site to the capsule and the Astronaut may key his telemetry transmitter in the capsule (on a continuous-wave basis) for transmission to the ground locations.

All communication between site and capsule is channeled through a communications technician console located in the Range Operations Building. The Communications Technician monitors all receivers for selection (for the use of the Flight Controllers) of either the HF or the UHF receiving system and the better signal of the system selected.

The selected system and signal is then made available to the flight controller consoles.

Inputs to the communications technician console are audio from the HF and UHF air-ground receivers and audio from the flight controller consoles which are equipped for capsule communication.

Outputs from the console include:

a. Audio modulation for HF and UHF transmitters;

b. Test signals for both receiver systems;

c. All audio traffic to tape recording facilities;

d. Receiver audio to the flight controller consoles.

Receiving system reliability is ensured by the use of two frequency bands, antenna space diversity, two receivers per frequency, and the versatile switching arrangements at the communications technician console.

The UHF receiving system uses the same quad-helix antenna arrays that are used for the telemetry system. Two separate preamplifiers and receivers are used, with the receiver outputs feeding a diversity combiner where the signals are combined to add their output strength and minimize noise. Three outputs are available from the combiner: receiver #1, receiver #2, or the composite signal. These outputs are amplified and fed to the communications technician console for selection of the best signal.

The HF receiver outputs are normally processed by a diversity relay actuator which automatically selects the stronger of the incoming signals. This signal is compared with the UHF signal at the communications technician console, where the better signal is selected for application to the flight controller air-ground receiving network. The HF receiver outputs also are brought directly to the communications technician console, by passing the HF diversity relay actuator, where either receiver output can be selected as described above.

Both HF and UHF transmitters can be either keyed individually or simultaneously. Each transmitter has a nominal output of 100 watts.

The transmitter and receiver antenna pedestals are steerable, under control of the acquisition system.

NOTE

All voice transmissions to and from the capsule will be recorded on magnetic tape to provide a permanent record at the site.

8.2.6 Radar System

The radar system at Point Arguello consists of a Verlort (S-band) and FPS-16 (C-band) radar. See figure 8-6.

The Verlort radar supplies precise tracking data within its nominal range of 700 miles. After processing by conversion equipment, this data is sent by teletype to the Goddard computing center. In addition, the Verlort supplies data to the acquisition system for site antenna positioning when in a valid tracking mode. The site antennas can be slaved to this acquistion information through the acquisition data console so that they are directed toward the capsule. The location of the Verlort radar is shown in Figure 8-9, the floor plan in Figure 8-16.

The FPS-16 radar has a narrow beamwidth which provides precise tracking data throughout its nominal 500-mile range. Data handling requirements for conversion to teletype format apply. This radar system is incorporated into the acquisition system both as a directed and as a directing unit as is the Verlort radar. The location of the FPS-16 radar is shown in Figure 8-9, the floor plan in Figure 8-16.

Switches mounted on a wall in the FPS-16 Building permit switching the AN/FPS-16 from existing range operations to Mercury operations.

8.2.7 Command Transmitting System (See Figures 8-7 and 8-11.)

Radio command control is required from prelaunch to flight completion to furnish ground command backup of internally programmed

capsule events. These commands can also terminate a flight by setting the retrotimer in the capsule, which controls firing of the retrorockets, as well as by initiating other vital steps in terminating a flight.

A 10-kilowatt (kw) transmitting power amplifier is used in conjunction with two FRW-2 (one master, one standby) 500-watt transmitters. The FRW-2 units are normally used to modulate the 10-kw amplifier but each can be used as command control transmitters in case of failure of the 10-kw amplifier. System operation in case of component failures is as follows. See figure 8-7.

a. An automatic monitor and switchover system detects failure of the regular (master) 500-watt FRW-2 unit used to modulate the 10-kw final amplifier. An automatic switchover then replaces the master FRW-2 unit with the standby unit.

b. Failure of the 10-kw amplifier is detected by the monitor and switchover system. Coaxial switches are then actuated to bypass the 10-kw amplifier and to use the FRW-2 (500 watt) master unit as the command transmitter.

c. Failure of the FRW-2 (500 watt) master unit results in an automatic switchover to the remaining FRW-2 (also 500 watt) standby unit as the command transmitter.

d. Two coders are used for this system, one for the master and one for the standby FRW-2 units. Both coders are used simultaneously during system operation. A monitoring device detects failure of either coder or FRW-2 unit (indicated by a lack of modulation at the associated FRW-2 unit) and causes switchover to the remaining coder—FRW-2 unit combination.

e. Excessive distances between the coder controller equipment (at the Control Center) and the coders (at the transmitting equipment location) require the use of a command coder multiplex remoting system to improve transmission of information between these locations. Dual cable facilities are provided to ensure reliability.

f. Antenna patching facilities provided enable the system to be changed from the normal quadhelix antenna array to a standby antenna. The antenna system is steerable under control of the acquisition data console in the Telemetry Building. A synchro remoting system is used between console and pedestal to control the pedestal, due to the distance between these locations.

An FRW-3 receiver is provided at the Range Operations Building for monitoring the transmitted commands to the capsule. After demodulation, these commands are then decoded (by a KY-172 unit) and are recorded in the control area. This device allows comparison of the commands initiated at the capsule communicators console with the commands actually transmitted, thereby verifying system accuracy.

NOTE

An emergency form of voice communition with the capsule is available at sites having command control transmitters. The command transmitter can be voice modulated for transmitting to the capsule and the telemetry transmitter in the capsule or it can be keyed for interrupted continuous-wave (ICW) transmission to the site.

8.3 EQUIPMENT ALLOCATIONS

Table 8-1 lists major equipments grouped by system and the manufacturer or source from whom the equipment is obtained.

8.4 EQUIPMENT LOCATIONS

The locations of the various equipments are shown on Figures 8-9 through 8-16 and Figure 6-27.

8.5 SITE ADMINISTRATION

Site administration is shown in chart form in Figure 8-17.

8.6 GEOGRAPHIC AND CLIMATIC DATA

Point Arguello is located on the California coast, west of Lompoc and approximately 180 miles north of Los Angeles (Figure 8-8).

Site coordinates are latitude 34°35′ N, longitude 120°34′ W.

The climate is relatively mild with an average temperature of 63°F in the summer and

TABLE 8-1

EQUIPMENT ALLOCATIONS—POINT ARGUELLO

System	*Equipment*	*Type or Model*	*Supplied By*
Acquisition	Active Acquisition Aid		
	Acquisition Data Console		Cubic
	Acquisition Data Console (includes Acquisition Aid Console)		Bendix Radio
	Synchro Remoting System	Electrospan	Bendix Pacific
Radar	S-band	Verlort	Reeves (existing facilities)
	C-band	FPS-16	RCA (existing facilities)
Telemetry	Preamplifiers	PR-203	Nems-Clarke
	Receiver	1412	Nems-Clarke
	Receiver	1434	Nems-Clarke
	Diversity Combiner	DCA-500	Nems-Clarke
	Decommutators 90/90	TDS-90	Arnoux
	Decommutators 90/15	TDS-90	Arnoux
	Descriminators	TDA-102	Bendix
	Tape Recorder	FR-114	Ampex
Displays	Capsule Communicator		Bendix
	Aeromedical Observer		Bendix
	Capsule Observer		Bendix
Capsule Command Transmitting System	Transmitter (10-kw)	240 D-2	Collins-Alpha
	Transmitter (500-watt)	AN/FRW-2	Collins-Alpha
	Command Coder Multiplex Remoting System	Type 230 Model 1	Northern Radio
	Coder	KY-171	Collins-Alpha
	Coder Controller	C 1669/URW	Collins-Alpha
Air-Ground Communications	HF Transmitter	CS-2029	Gates
	HF XMTR-Remote Control	177L-2	Collins
	HF Receiver	R390A/URR	Collins
	UHF Transmitter	GRT-3	Radio Receptor
	UHF Receiver	R278B/GR	Collins

50°F in the winter. The average yearly rainfall is 12 inches, with the heaviest rainfall between the months of December and March. High and low temperature and relative humidity figures are as follows:

	Temperature		*Relative Humidity*	
	High	*Low*	*High*	*Low*
Summer	102°F	44°F	95%	50%
Winter	87°F	22°F	85%	15%

There is an average of two severe storms during the year, occurring during the winter season.

8.7 TRANSPORTATION AND COMMUNICATIONS

There are four flights daily (two north and two south) from Santa Maria by Pacific Air Lines. There is also scheduled service by the same airlines and by United Air Lines at Santa Barbara.

The Southern Pacific Railroad (coast line) serves the area with a station at Surf which is four miles from the main gate of the site. There is also Greyhound Bus Service at Lompoc.

Travel within the site is by automobile exclusively. There is no local bus service in Lompoc.

The General Telephone Company of California serves the area.

8.8 SITE PERSONNEL FACILITIES AND SERVICES

Housing has been scarce due to the population increase caused by expansion of the military bases in this area. The situation is reported to be easing, with these rental costs typical:

Houses—3 bedrooms, unfurnished $165 per month and up;
2 bedrooms, unfurnished $125 per month and up;

Apartments—1 and 2 bedrooms, unfurnished $105 to $140 per month and up.

There are six motels and two hotels in the Lompac area. The rates vary upward from $8.00 per night for a single room.

Rentals of trailer park facilities, which are available, start at $40.00 per month.

There are hospitals in Lompoc and at the Vandenberg Air Force Base. The local range facility maintains a medical dispensary.

Swimming, fishing, hunting, golf, movies, and library facilities are available. Four television stations and numerous radio stations serve the area. Television reception in the area is considered of good quality.

The airmail delivery time to New York City is approximately two days.

The religious denominations found in Lompoc are: Assembly of God, Baptist, Christian Science Society, Catholic, Latter-Day Saints, Episcopal, Methodist, Lutheran, Presbyterian, and Pentecostal.

A variety of clothing is necessary due to the temperature variations as noted in paragraph 8.6. Local stores supply a wide variety of clothing and other consumer products.

8.9 MISCELLANEOUS INFORMATION

Two banks in the town of Lompoc (savings and commercial) provide complete banking services.

The State of California has both a personal income tax and a sales tax. The sales tax is in the amount of 4 percent but does not apply to food purchases. The income tax is progressive, based on income versus dependency and deductions. A sample of this tax for 1959 is $10,000 income, 4 dependents, $39.00 tax. Local property taxes are variable, depending on the locality, the tax rate, and assessing practices of the area. Information available indicates the following (approximate) property taxes in the area:

Cost of Home	*Tax*
$16,000	$250.00
12,000	188.00

Prices, costs, and rentals quoted are in accordance with the best information available at the time of this writing. Inasmuch as they are subject to change with the passing of time, it is suggested that items of particular personal interest be further verified through appropriate channels.

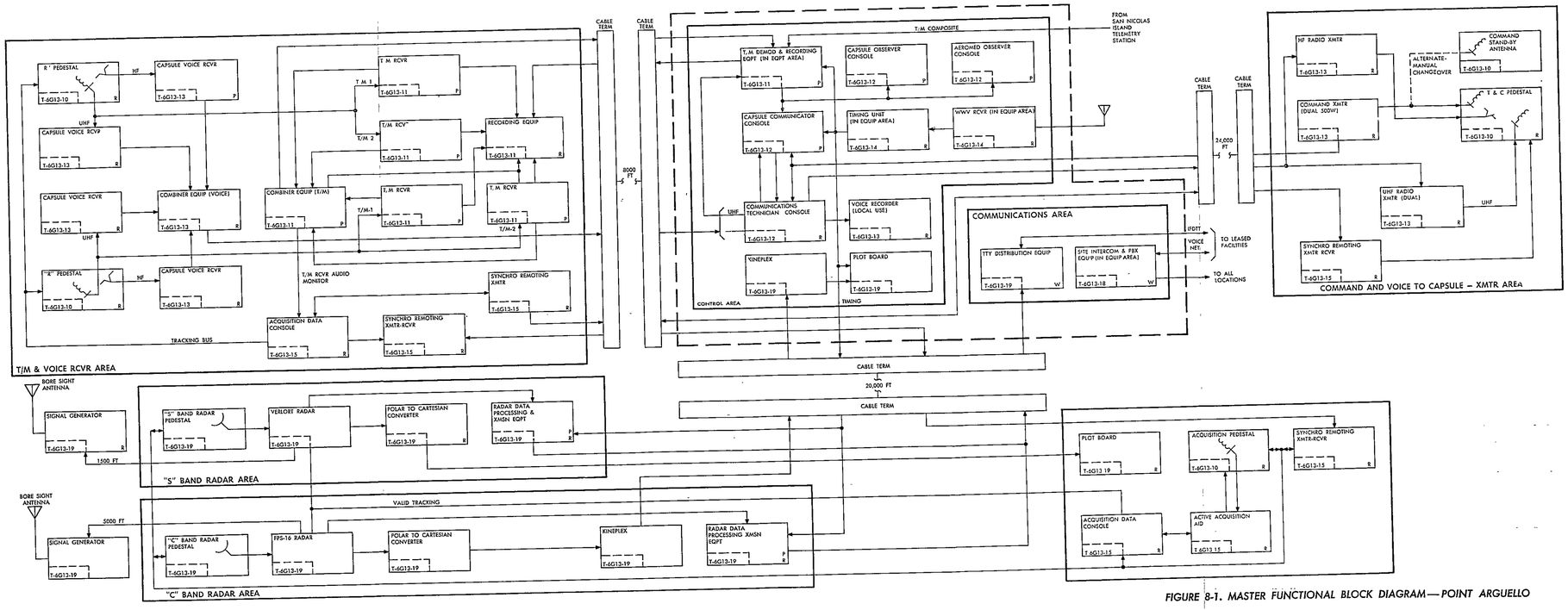


FIGURE 8-1. MASTER FUNCTIONAL BLOCK DIAGRAM — POINT ARGUELLO

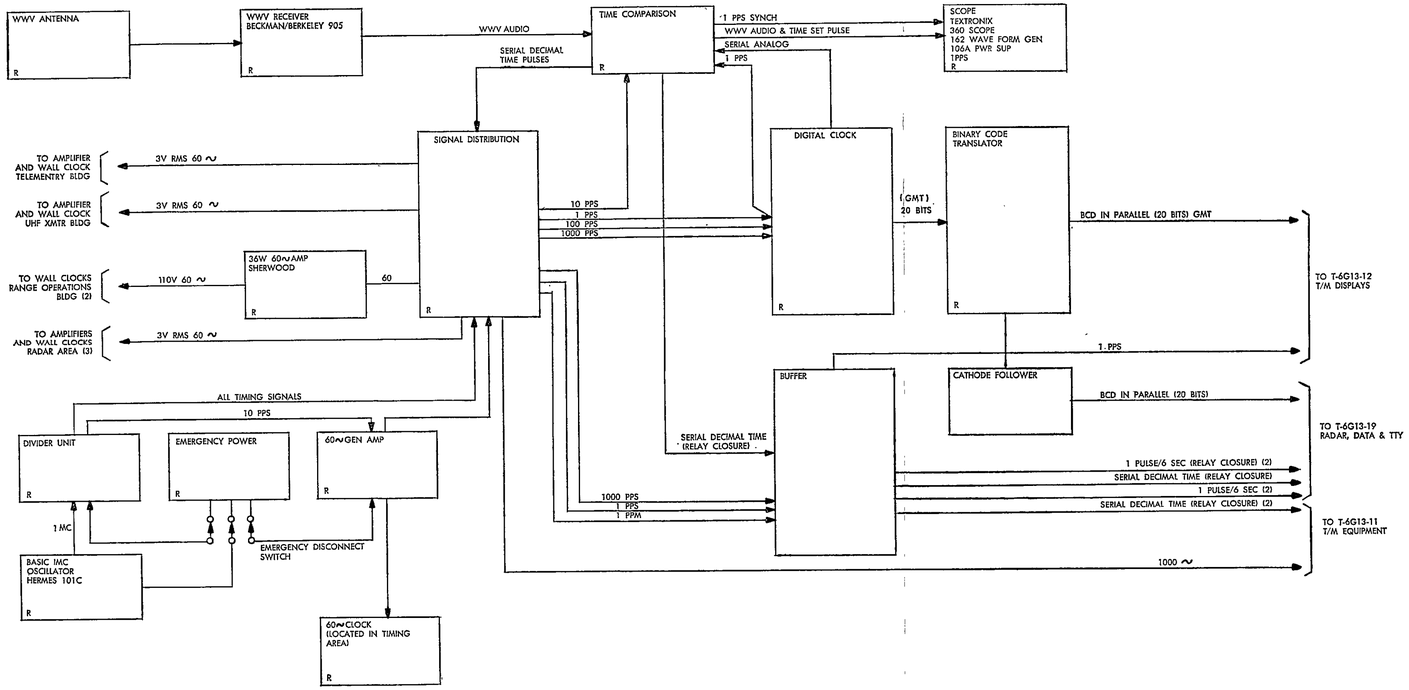


FIGURE 8-2. FUNCTIONAL BLOCK DIAGRAM, TIMING SYSTEM—POINT ARGUELLO

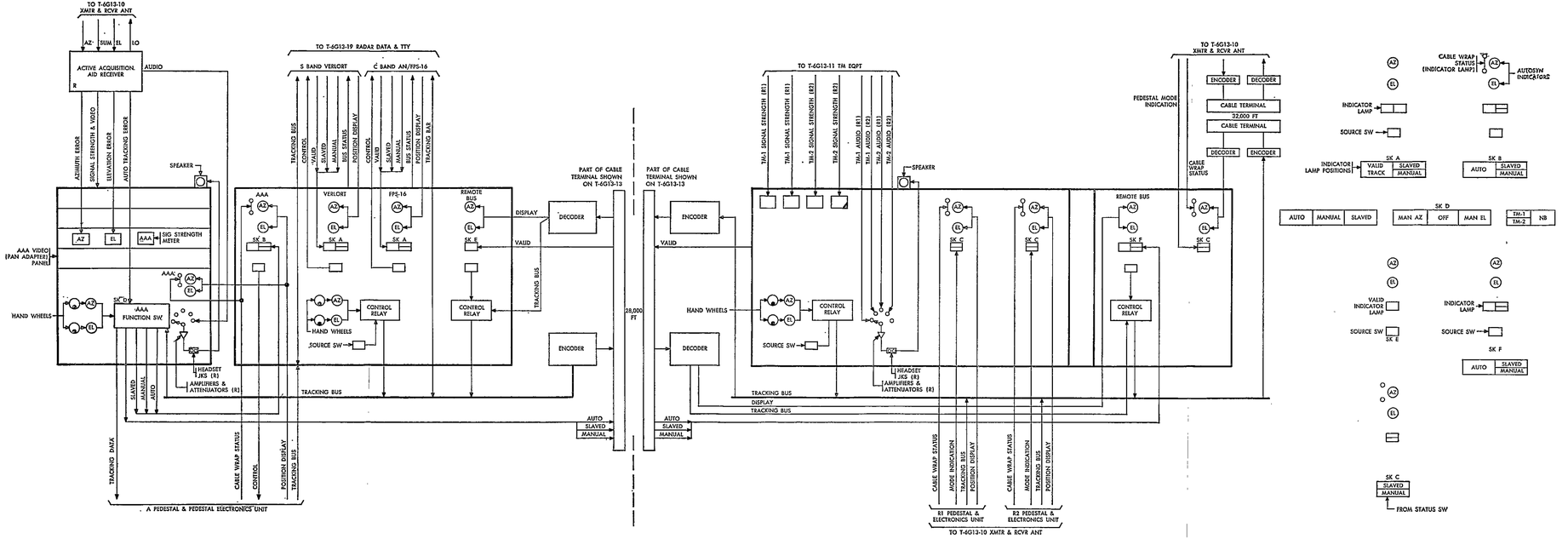


FIGURE 8-3. FUNCTIONAL BLOCK DIAGRAM, ACQUISITION SYSTEM — POINT ARGUELLO

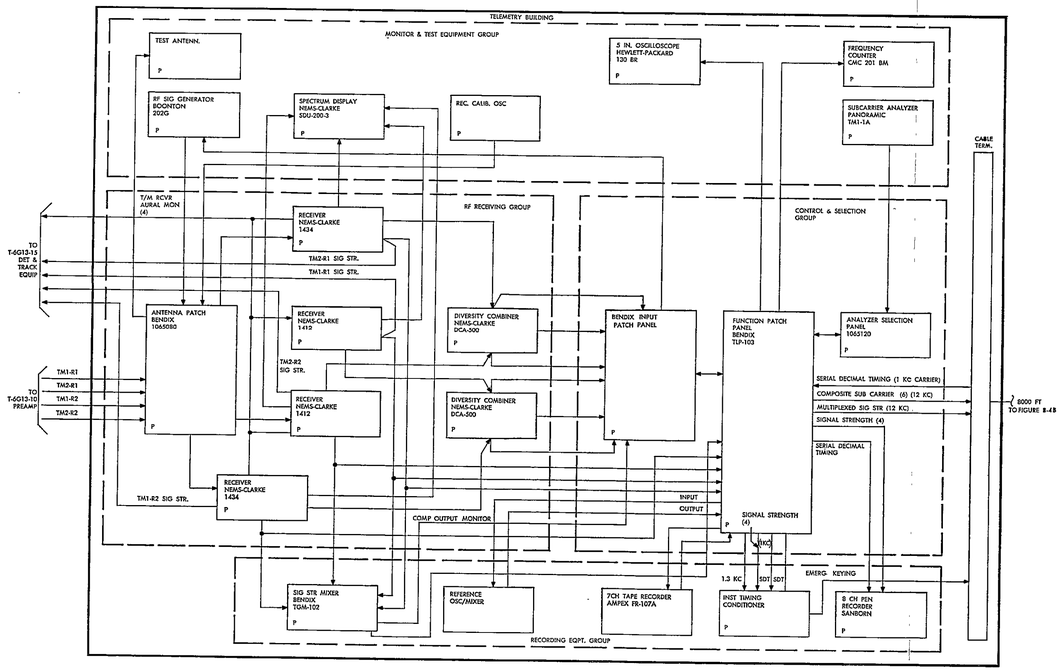


FIGURE 8-4. FUNCTIONAL BLOCK DIAGRAM, TELEMETRY SYSTEM—POINT ARGUELLO

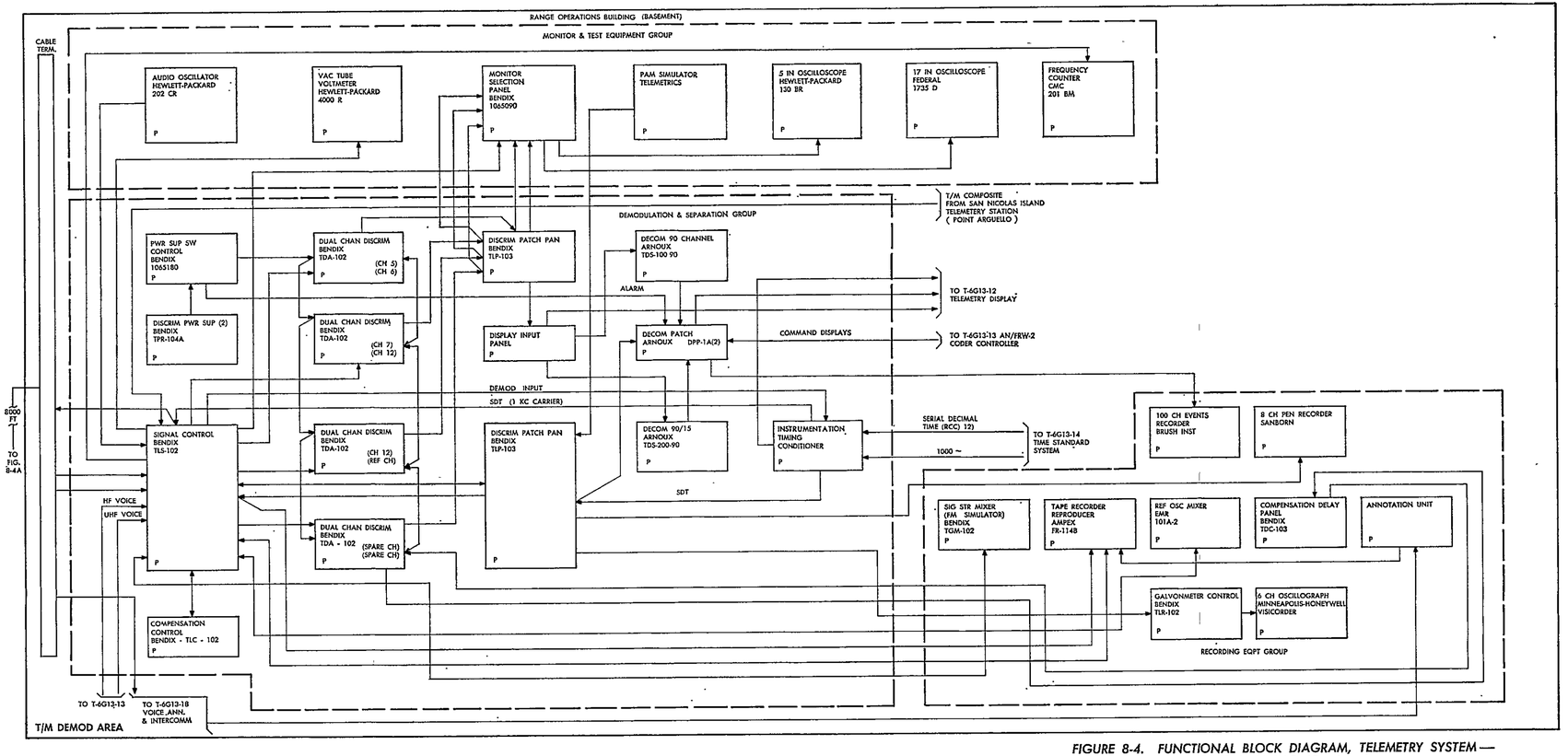


FIGURE 8-4. FUNCTIONAL BLOCK DIAGRAM, TELEMETRY SYSTEM — POINT ARGUELLO (Continued)

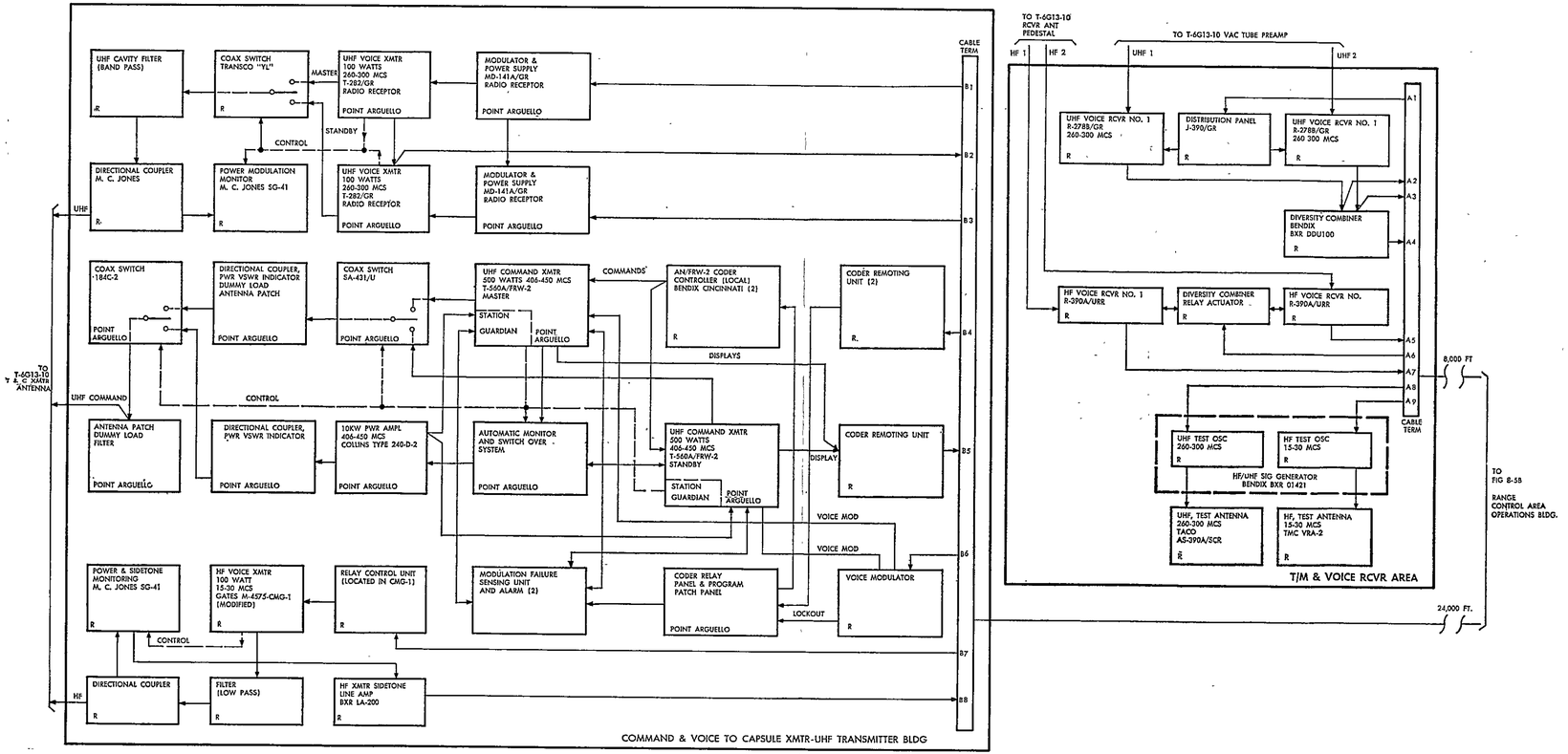


FIGURE 8-5. FUNCTIONAL BLOCK DIAGRAM, CAPSULE COMMUNICATION SYSTEM— POINT ARGUELLO

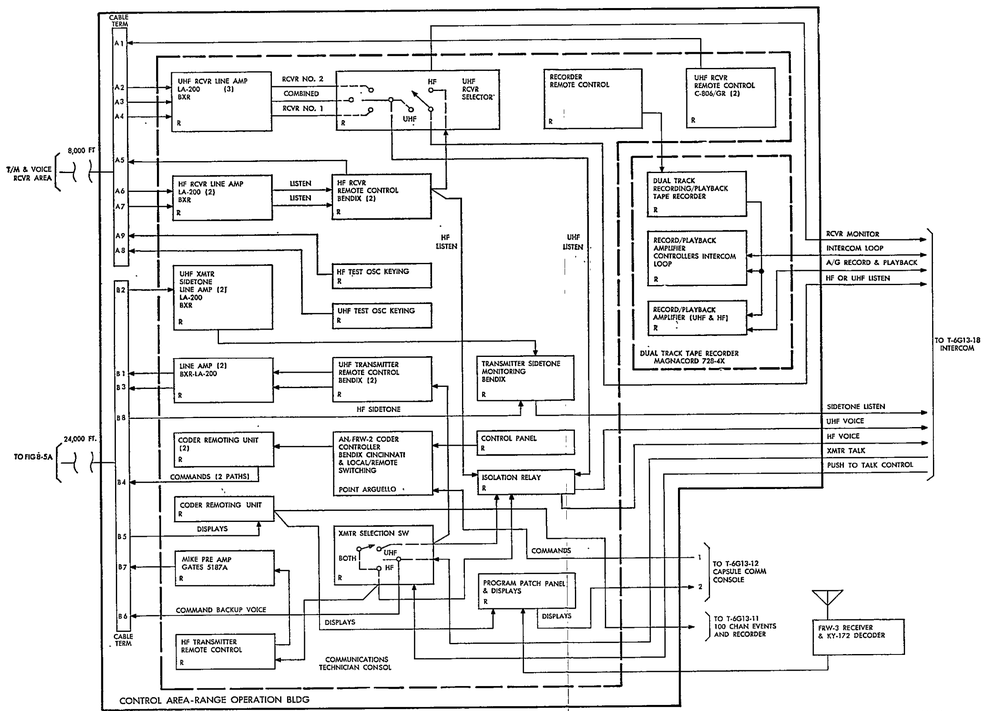


FIGURE 8-5. FUNCTIONAL BLOCK DIAGRAM, CAPSULE COMMUNICATION SYSTEM — POINT ARGUELLO (Continued)

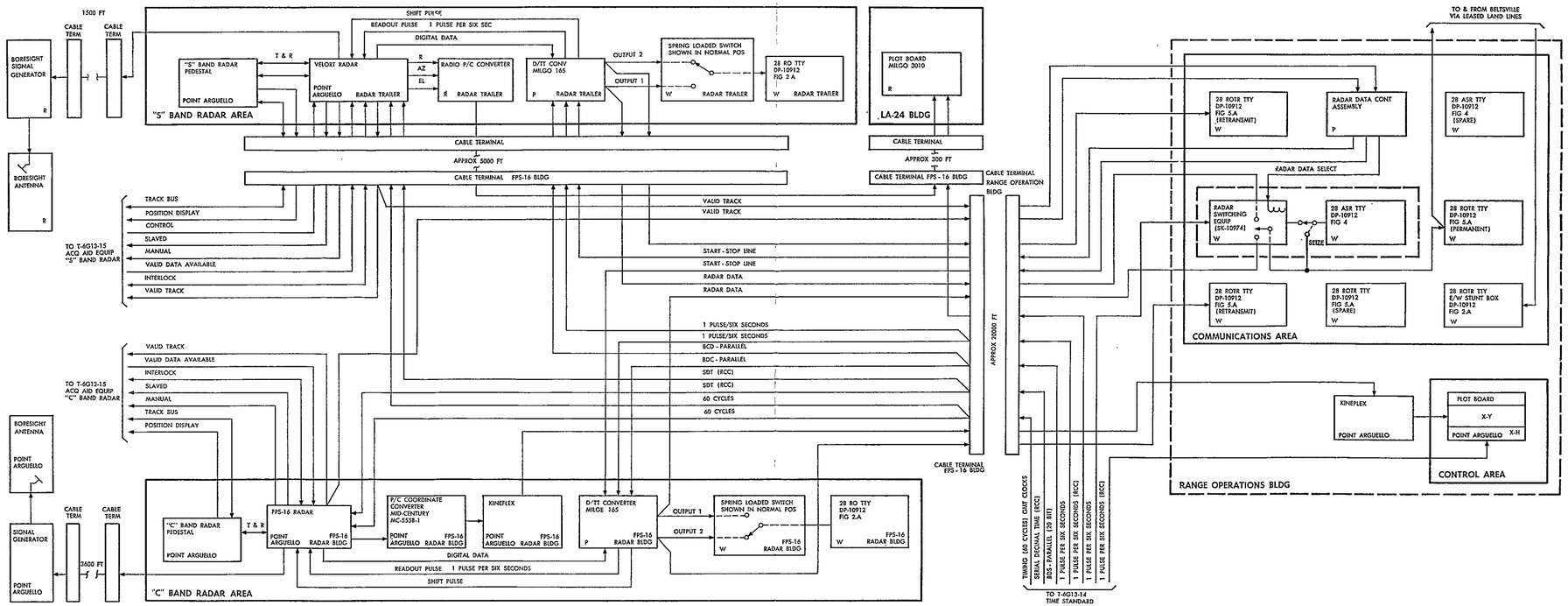
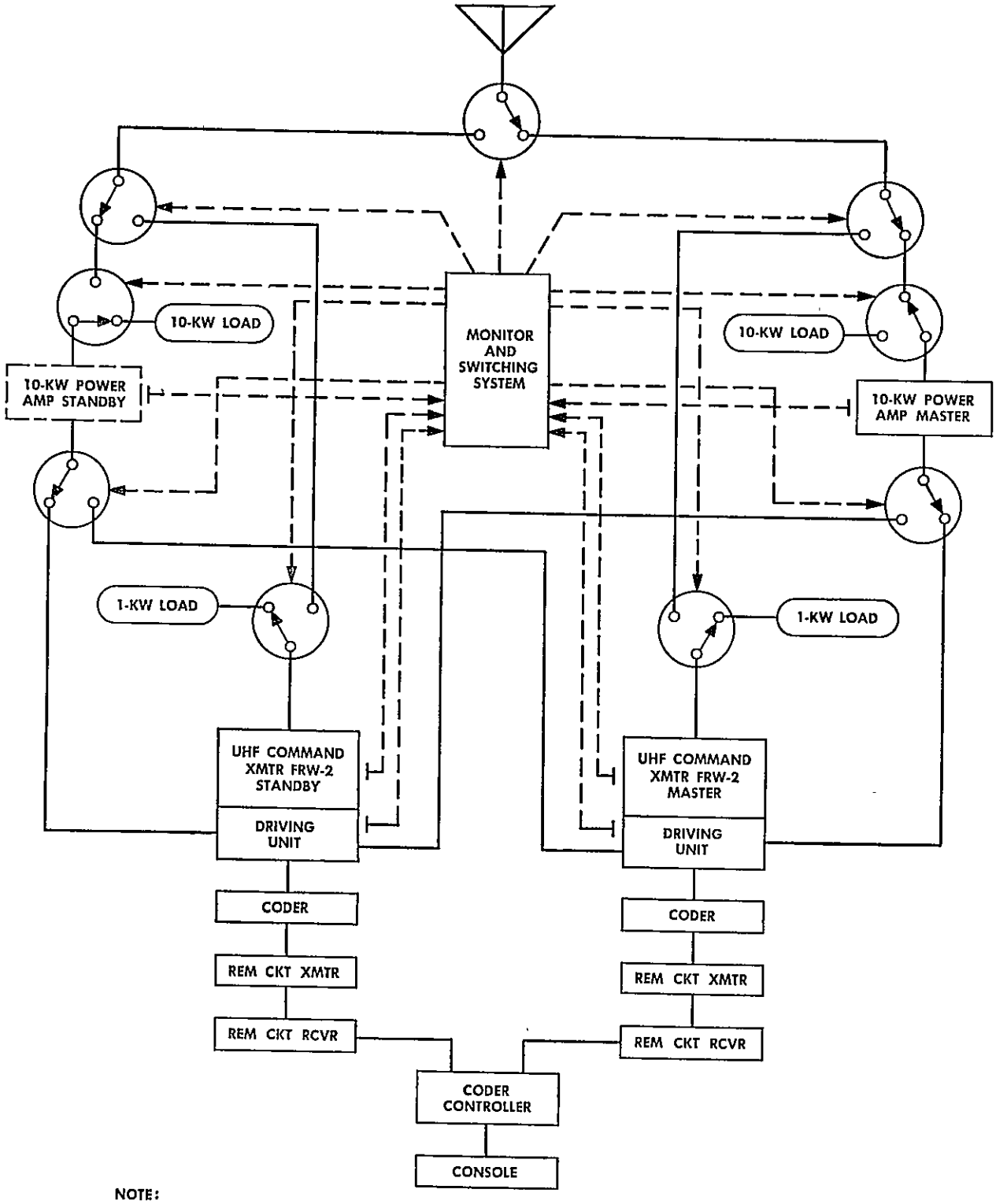


FIGURE 8-6. FUNCTIONAL BLOCK DIAGRAM, RADAR SYSTEM — POINT ARGUELLO



NOTE:
1. DASHED LINES INDICATE MONITORING AND SWITCHING
2. STANDBY 10-KW POWER AMPLIFIER NORMALLY DEENERGIZED

FIGURE 8-7. CAPSULE COMMAND TRANSMITTER SYSTEM—POINT ARGUELLO

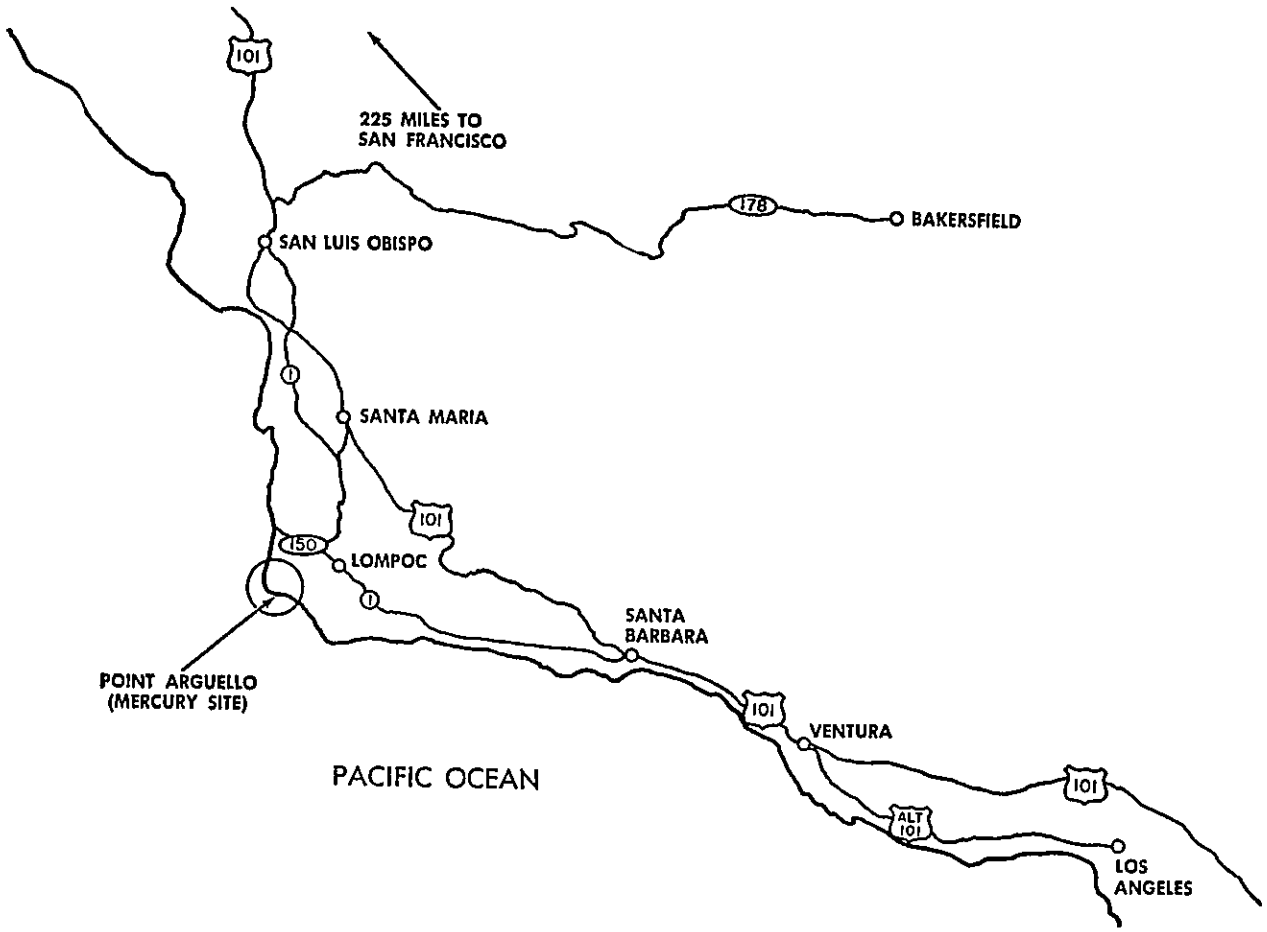


FIGURE 8-8. AREA MAP — POINT ARGUELLO

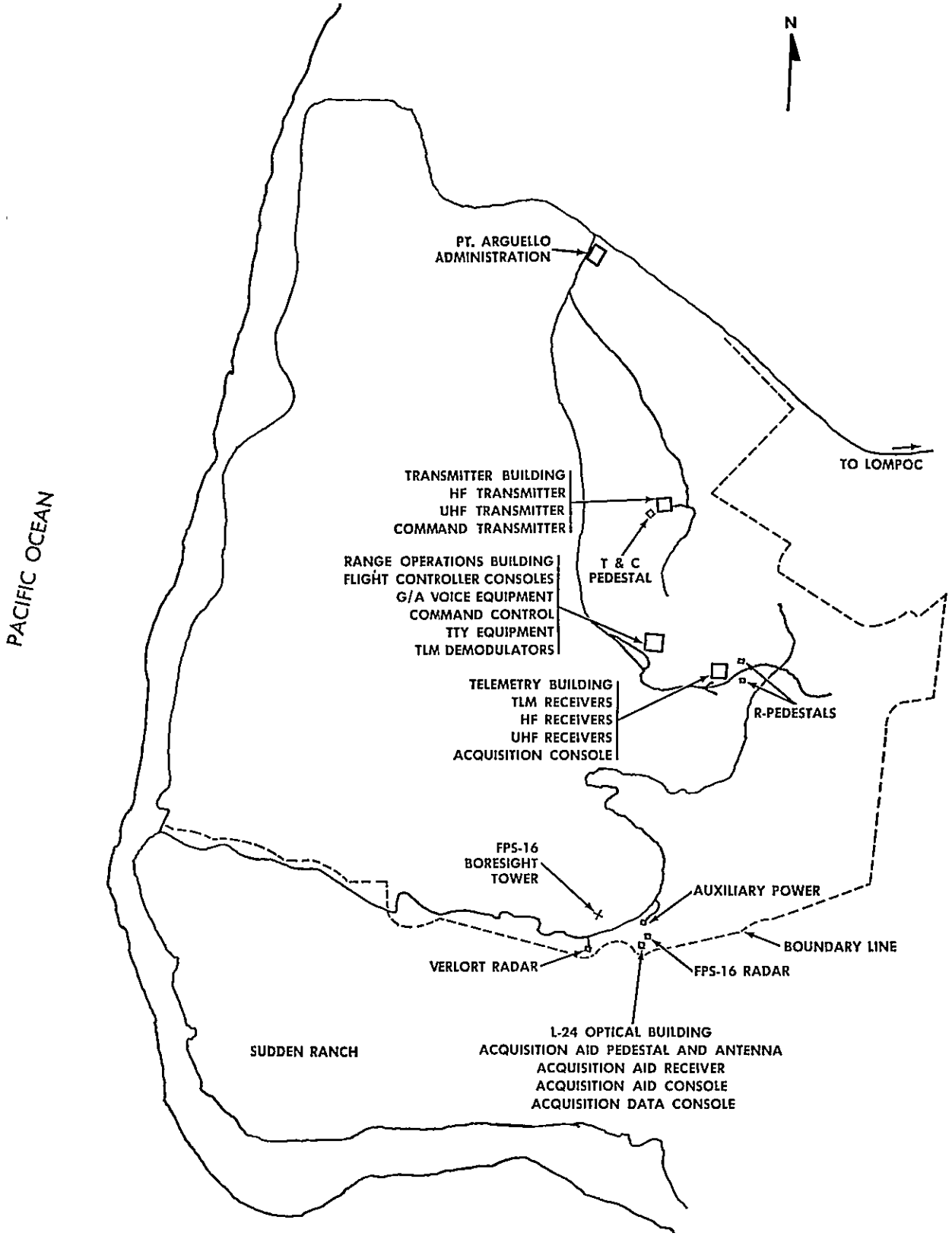


FIGURE 8-9. SITE LOCATION — POINT ARGUELLO

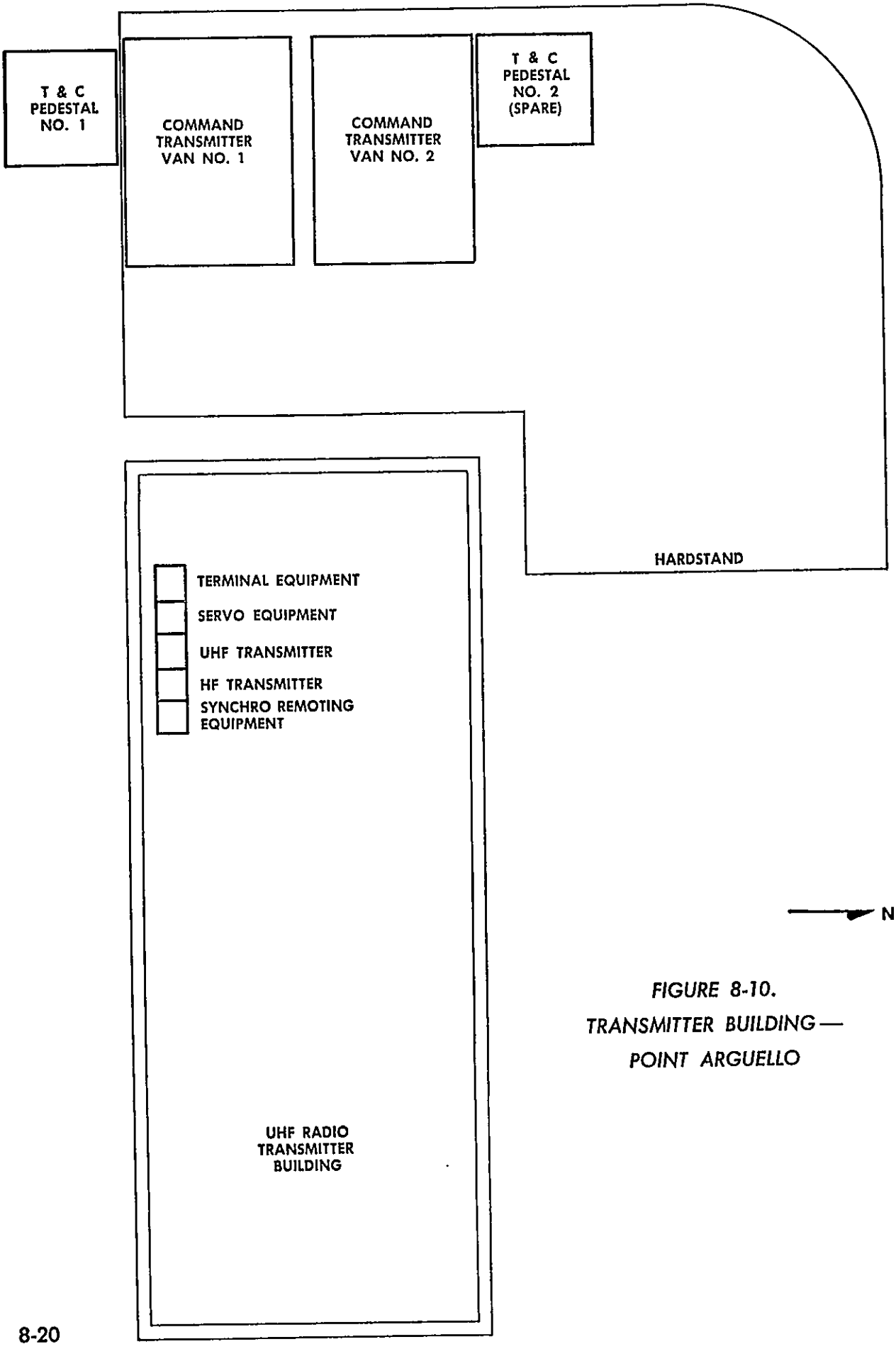


FIGURE 8-10.
TRANSMITTER BUILDING — POINT ARGUELLO

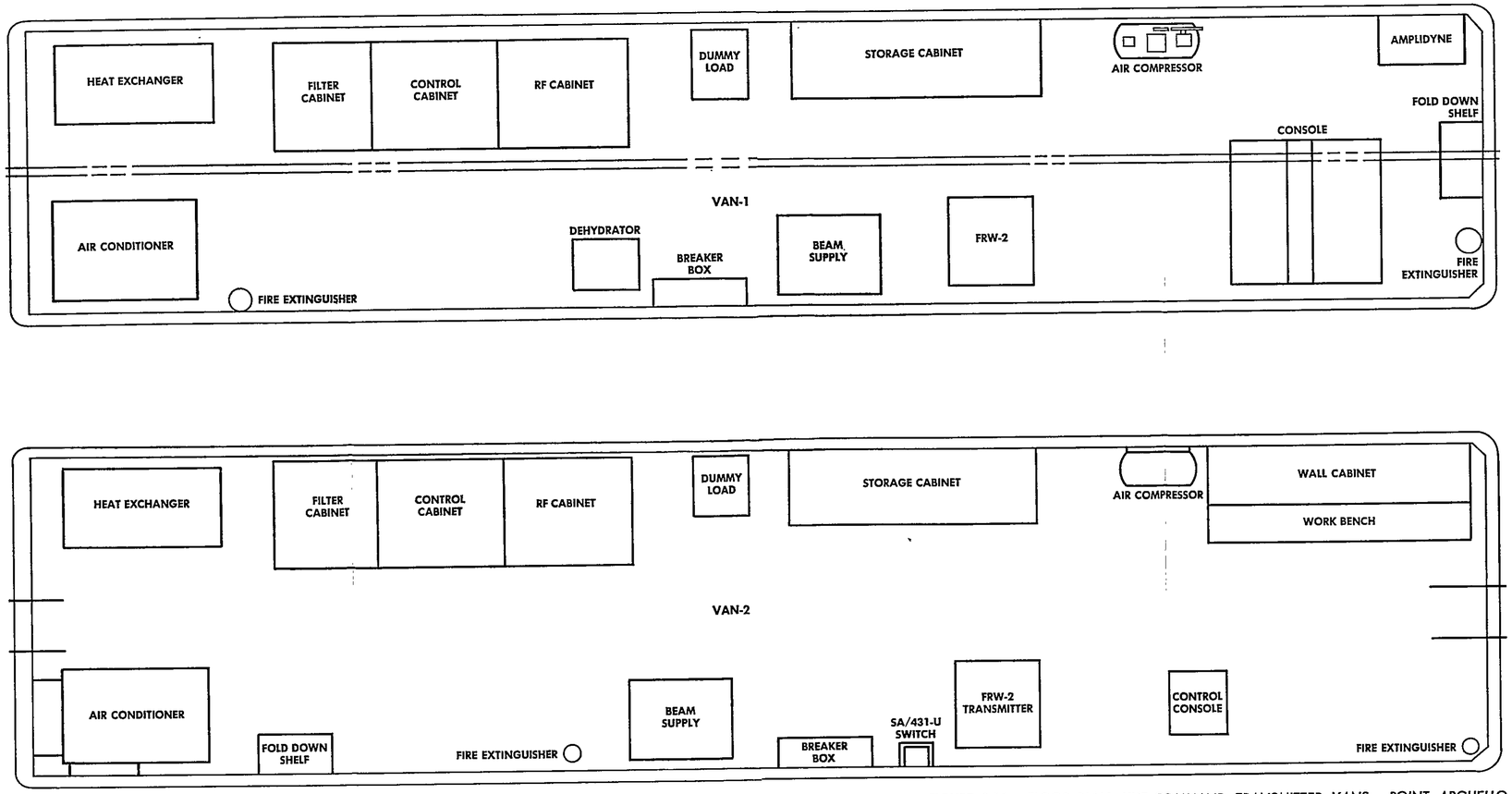


FIGURE 8-11. FLOOR PLAN, UHF COMMAND TRANSMITTER VANS—POINT ARGUELLO

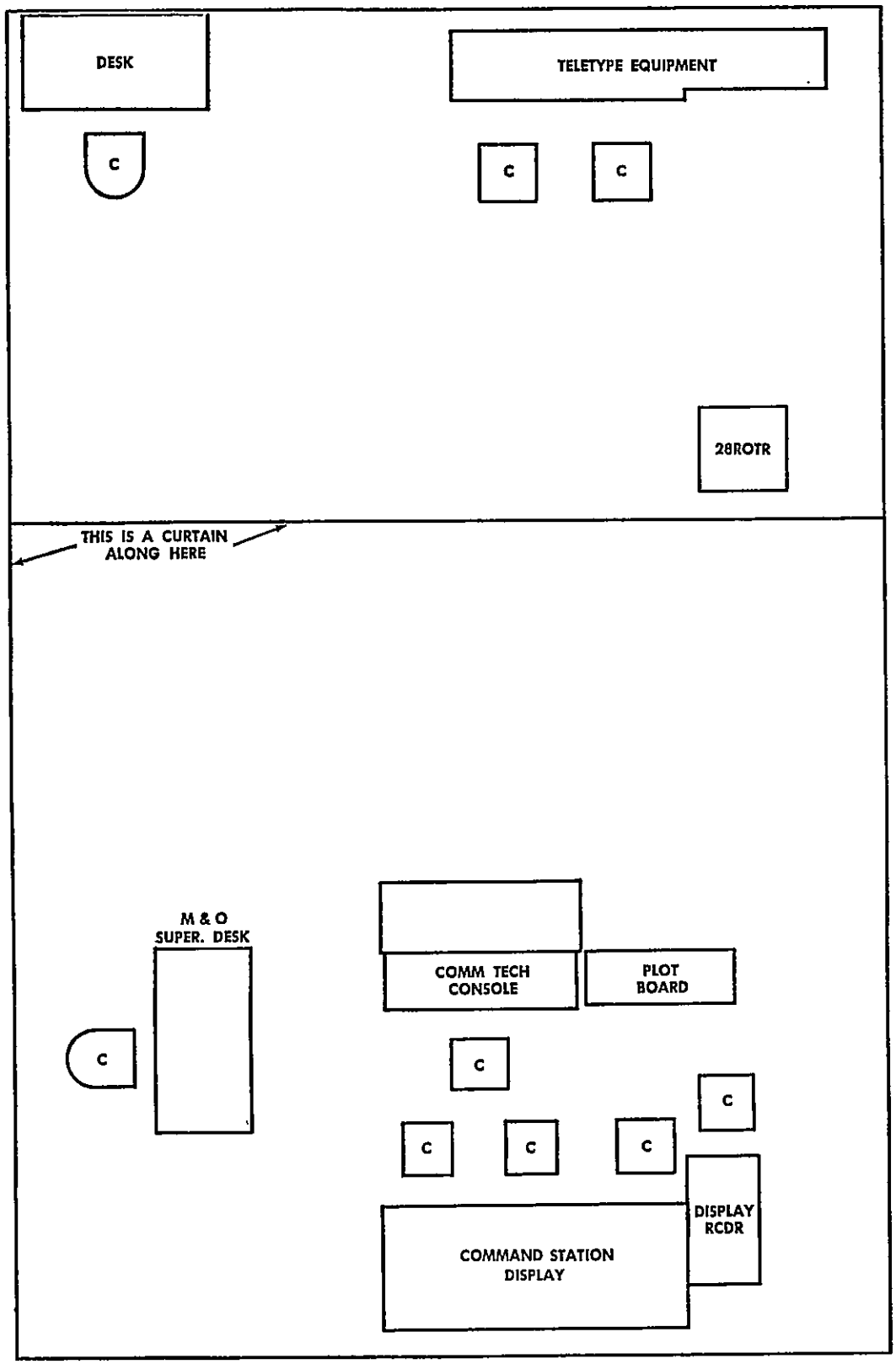


FIGURE 8-12. ROOM 224, RANGE OPERATIONS BUILDING — POINT ARGUELLO

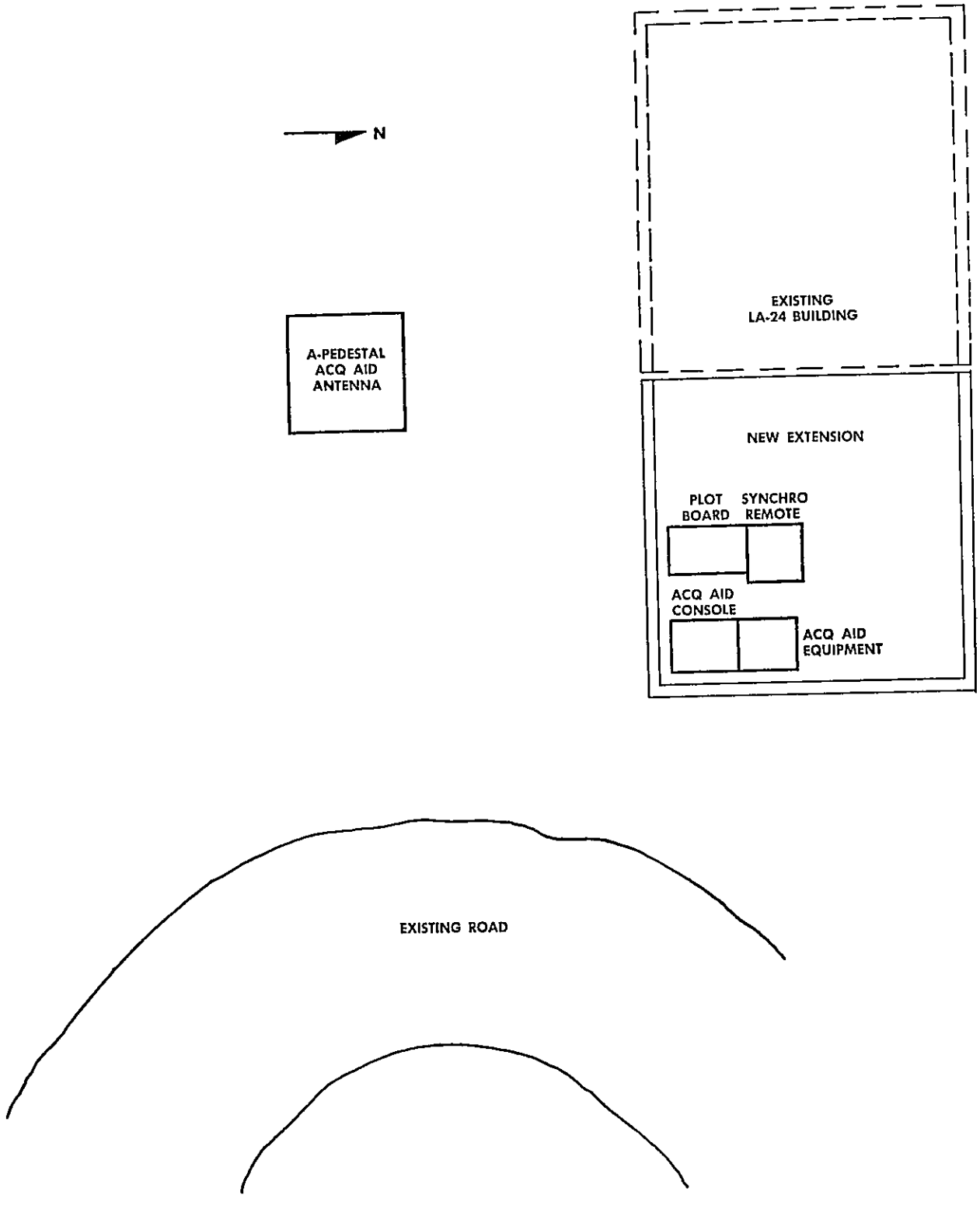
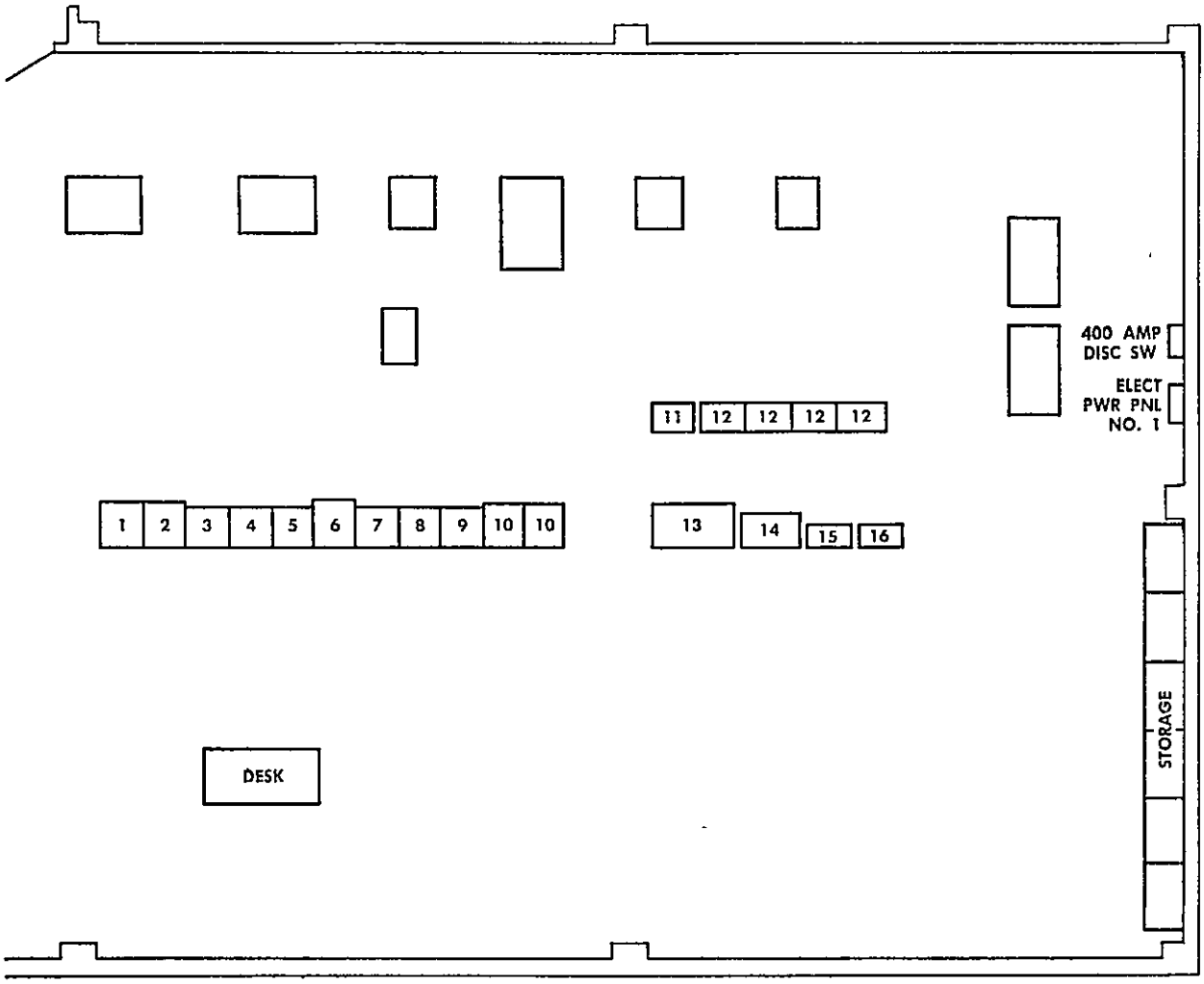


FIGURE 8-13. LA-24 BUILDING, ACQUISITION AID EQUIPMENT — POINT ARGUELLO



NOTE: BOXES NOT MARKED ARE EXISTING RANGE EQUIPMENT

LEGEND

1. TAPE RECORDER
2. REPRO PRECISION
3. CONT
4. CALIBRATOR
5. DISCRIMINATOR
6. DECOM MONITOR
7. 90/90 DECOM
8. 90/15 DECOM
9. EVENTS RECORDER
10. PEN RECORDER
11. CABLE RACK
12. 112 KEY EQUIPMENT
13. TIMING STANDARD
14. 105D POWER PLANT
15. MISCELLANEOUS POWER
16. DISTRIBUTION FRAME

FIGURE 8-14. EQUIPMENT LOCATION, RANGE OPERATIONS BUILDING—POINT ARGUELLO

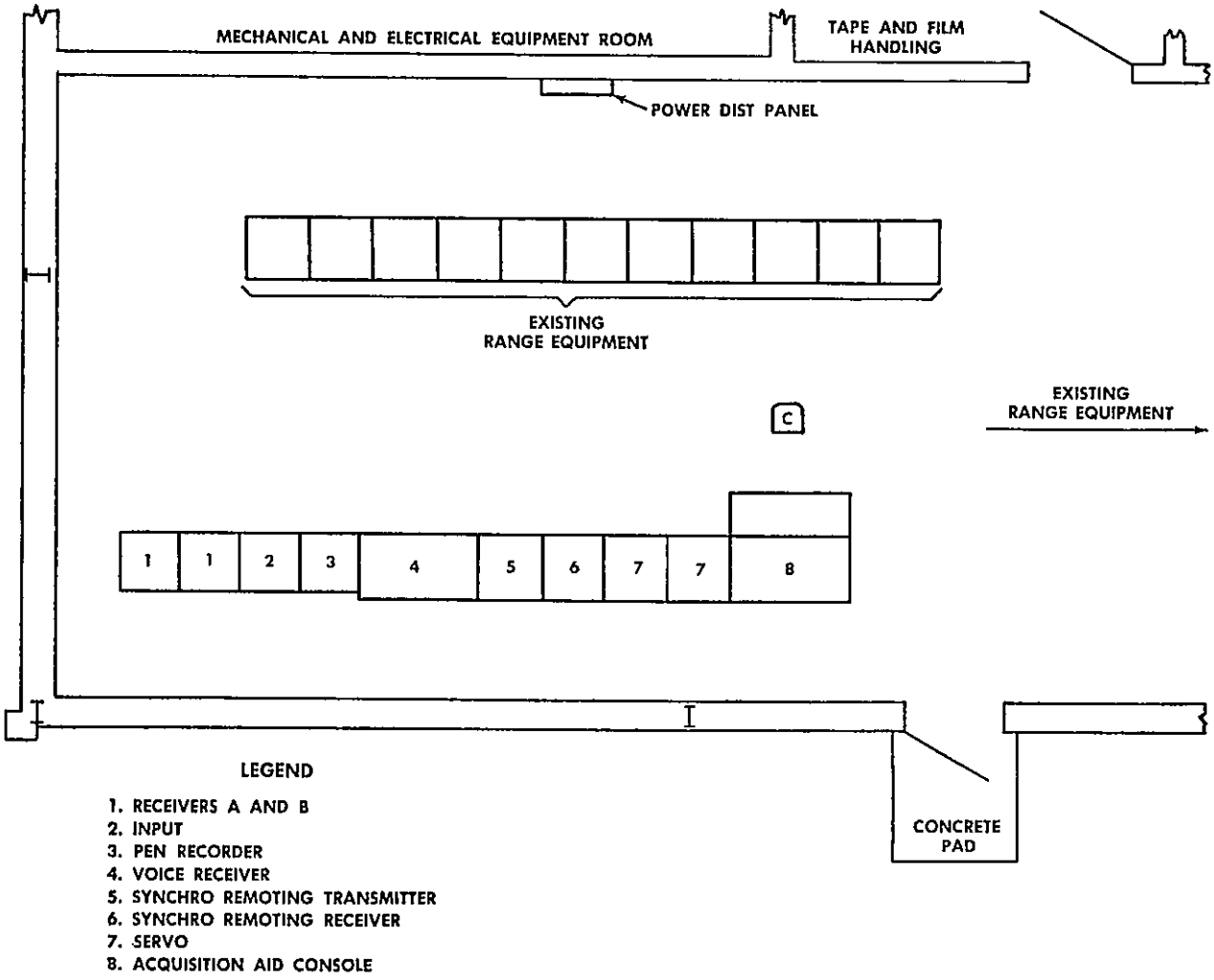


FIGURE 8-15. EQUIPMENT LOCATION, TELEMETRY BUILDING — POINT ARGUELLO

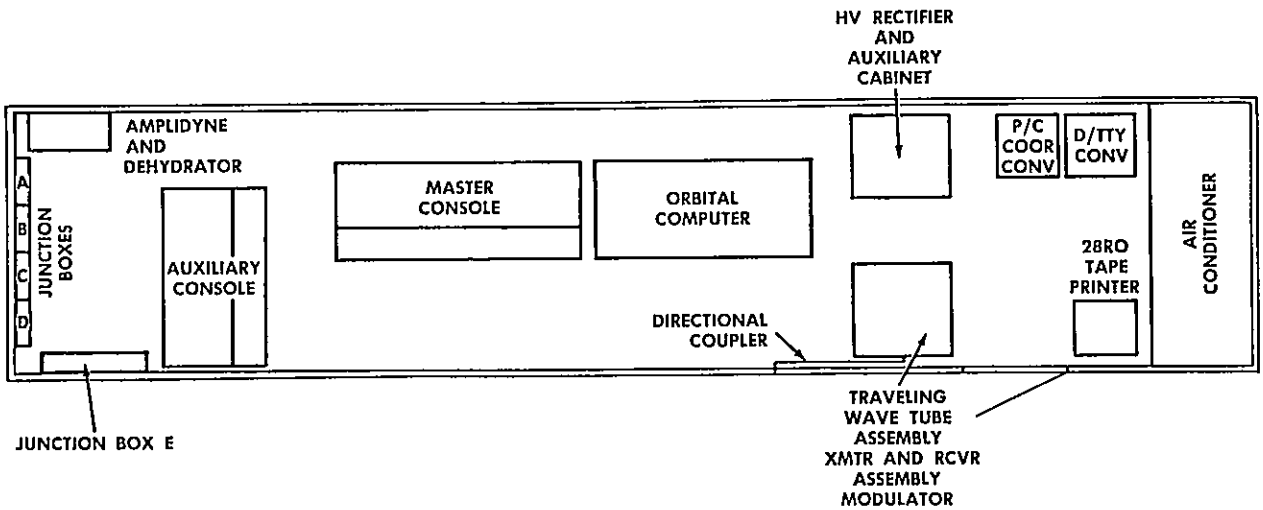
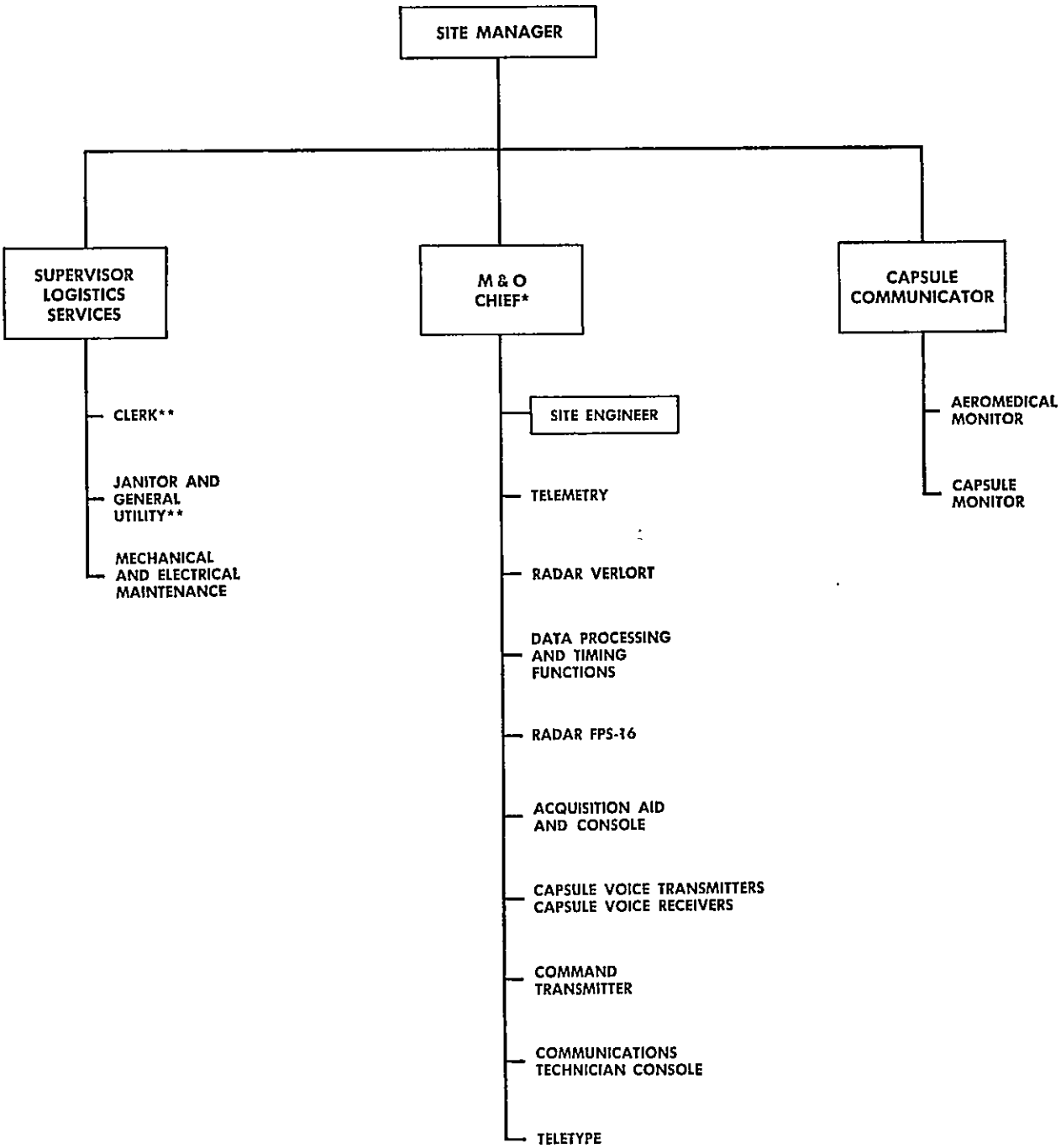


FIGURE 8-16. VERLORT RADAR VAN — POINT ARGUELLO



*OPERATES TECHNICIANS INTERCOM POSITION
**DURING FLIGHT OR DRILL, ASSISTS IN MESSENGER SERVICE AND MONITORS RECEIVE-ONLY TELETYPE EQUIPMENT

FIGURE 8-17. SITE ADMINISTRATION — POINT ARGUELLO

Section 9

WHITE SANDS AND EGLIN

TABLE OF CONTENTS

Paragraph	*Title*	*Page*
9.1	Purpose of the Sites	9-1
9.2	Systems	9-1
	Ground Communications System	9-1
	Timing System	9-1
	Acquisition System	9-1
	Radar System	9-2
9.3	Equipment Allocations	9-3
9.4	Equipment Locations	9-3
9.5	Site Administration	9-3
9.6	Geographic and Climatic Data	9-3
	White Sands	9-3
	Eglin	9-3
9.7	Transportation and Communications	9-4
	White Sands	9-4
	Eglin	9-4
9.8	Site Personnel Facilities and Services (Housing, Medical Facilities, Recreational Facilities, Mail Service, Religious Facilities, Clothing, and Food)	9-4
	White Sands	9-4
	Eglin	9-4
9.9	Miscellaneous Information (Money and Taxes)	9-5
	White Sands	9-5
	Eglin	9-5

LIST OF ILLUSTRATIONS

Figure	*Title*	*Page*
9-1	Master Functional Block Diagram —White Sands	9-7
9-2	Master Functional Block Diagram —Eglin	9-8
9-3	Functional Block Diagram, Timing System—White Sands and Eglin	9-9
9-4	Functional Block Diagram, Acquisition System—White Sands	9-11
9-5	Functional Block Diagram, Acquisition System—Eglin	9-13
9-6	Functional Block Diagram, Radar System—White Sands	9-14
9-7	Functional Block Diagram, Radar System—Eglin	9-15
9-8	Area Map—White Sands	9-17
9-9	Equipment Location—White Sands	9-18
9-10	Area Map—Eglin	9-19
9-11	Equipment Location—Eglin	9-20
9-12	Site Administration—White Sands and Eglin	9-21

LIST OF TABLES

Table	*Title*	*Page*
9-1	Equipment Allocations — White Sands and Eglin	9-3

SECTION 9. WHITE SANDS, NEW MEXICO, AND EGLIN, FLORIDA

9.1 PURPOSE OF THE SITES

In addition to the functions and systems noted in Figure 1-1, the Eglin site is important to Project Mercury in that it is the only site, other than Cape Canaveral, which has a high-speed data-link input to the IBM 709 computer at Cape Canaveral. This data is used to assist radars in acquiring the capsule on the second and third passes.

9.2 SYSTEMS

See Figures 9-1 and 9-2.

9.2.1 Ground Communications System

The data from White Sands and Eglin is transmitted via leased facilities to the Goddard communications and computing center (Figure 1-3). In addition Eglin transmits data to Cape Canaveral on a high-speed data link.

9.2.2 Timing System

The timing system provides time correlation of data collected from the radar and it provides a driving source for the control area time displays (Figure 9-3). The time reference used is that of Greenwich Mean Time (GMT) expressed in hours, minutes, and seconds.

Time signals broadcast from Bureau of Standards radio station WWV are received at the site on receivers provided for this specific purpose. These signals are used as a reference standard against which a stable one-megacycle oscillator is compared and adjusted. Successive frequency division circuits supply frequencies from 1 kc to one cycle per minute. During this procedure, adjustments are made as necessary to synchronize the frequency of the locally generated signal with the frequency of the received signal. Further frequency divisions result in pulse-per-second and pulse-per-minute outputs. A check of the system is provided by a visual comparison on an oscilloscope of the one-pulse-per-second output of the timing system and the once-per-second tone burst of WWV. Important outputs of this system are as follows.

a. An output representing the GMT in hours, minutes, and seconds, is used in the data processing and data conversion equipment to time-tag the radar data, and to drive certain time displays.

b. A pulse from the timing equipment every six seconds causes radar data to be read out.

9.2.3 Acquisition System

Acquisition of the capsule by the tracking radar is expedited by the active acquisition aid equipment. See Figures 9-4 and 9-5.

Proper functioning of the system depends on error voltages. These voltages are developed by measurement of the time difference at which the signals transmitted by the capsule arrive at the different elements of the acquisition antenna. The magnitude of these error voltages is greater as the antenna points away from the capsule and are least when the antenna is aimed directly at the signal source.

The difference in arrival time of the signal at the antenna elements (phase difference) is measured by the acquisition aid receiver which is especially designed for this purpose.

The error voltages developed by the system are amplified and displayed on appropriate meters to aid a system operator in manually correcting the antenna position until the antenna pointing error is at a minimum, as seen on the meters. If, however, the system is in automatic operation, the error voltages are applied directly to the antenna pedestal, thereby repositioning it to keep it pointed at the target.

There is one console, the active acquisition aid control console, provided to control the operation of the acquisition system. Manual automatic or slaved operation of the acquisition aid antenna is controlled by this console. These types of operation are defined as follows.

a. Manual operation is the control of antenna position with handwheels located on the console. Visual indications are provided to show the azimuth and elevation coordinates selected with the handwheels.

b. Automatic operation is the control of antenna position by the active acquisition aid receiver without manual assistance. This is accomplished by the directional-sensing capabilities of a quad-helix antenna array (on the A-pedestal), associated hybrid, and acquisition receiver. A telemetry signal is converted into antenna positioning voltages after processing through this equipment.

c. Slaved operation is the control of the acquisition aid antenna by positioning voltages supplied by the radar antennas.

The strength of the signal received through the acquisition aid receiver is indicated by a signal strength meter. Error voltages, indicating the correction voltages applied to the acquisition aid antenna pedestal, are displayed on this console.

Cablewrap indicators (lamps on the console) are also supplied to indicate when the antenna rotation is either clockwise or counterclockwise from its midpoint and when rotational limits are reached because of permanent connection of antenna cable to the antenna.

Since the acquisition aid antenna receiving pattern has a 20-degree beamwidth, the active acquisition system is capable of acquiring the target early and furnishing refined capsule position information to the radars. The radars, with beamwidths of less than three degrees, can then acquire the target more readily, since the area to be searched has been greatly decreased.

System operation is as follows:

An operator receives an acquisition message which gives the expected coordinates (azimuth and elevation) and the expected time of arrival of the capsule at the site's geographical location. Additional information in this message indicates the expected coordinates, along the orbit, of the capsule at one-minute intervals after the time of the capsule's arrival.

The operator positions the handwheels until the appropriate indicators show that the antennas are pointed toward the coordinates given in the acquisition message. When the capsule signals are received by the system, and manual corrections of the antenna position have been made to obtain minimum error, the system is then placed in AUTOMATIC, and is left there as long as the system tracks the capsule signal. Additional features in the operation of equipment associated with the acquisition aid at these two sites are as follows.

At *White Sands* when the radar operator accepts control of the radar antenna position by the acquisition aid, the positioning voltages for the radar antenna are derived from a synchro located on the A-pedestal, rather than from a tracking bus within the console, which is the usual method of operation. The radar cannot provide controlling voltages to the console for control of the A-pedestal at any time due to the circuits at this site. The active acquisition aid mode switch, therefore, is never used in the slaved position, inasmuch as no positioning voltages are present at the contacts of the switch.

At *Eglin* the positioning voltages developed by the servo in the A-pedestal are returned through a servo control cabinet to the acquisition data console. Operation of the proper switch applies these voltages to the tracking bus, where they can be used to position either the MPQ-31 or the FPS-16 radar antennas or both. Reciprocal control of the A-pedestal by the radars can be had, when radar positioning voltages are present on the tracking bus of the consoles, by operation of the SLAVED switch on the active acquisition aid control console.

Positioning voltages are supplied to the acquisition data console by an additional acquisition aid system antenna which existed at this site prior to the Mercury installation and is used for tracking purposes other than those of Project Mercury. These positioning voltages also can be applied to the console tracking bus for control of the radar and the A-pedestal antennas. Control of this additional acquisition system antenna by the Mercury consoles, however, is not possible.

9.2.4 Radar System

See Figures 9-6 and 9-7 for functional block diagrams of the radar systems at the sites.

The MPQ-31 radar that is located at Eglin is the same as the Verlort radars which are located at other sites. The radar supplies precise tracking data within its nominal range of 700

TABLE 9-1

EQUIPMENT ALLOCATIONS — WHITE SANDS AND EGLIN

System	*Equipment*	*Type or Model*	*Supplied By*
Acquisition	Active Acquisition Aid		Cubic
	Acquisition Data Console		Bendix Radio
Radar	S-Band*	MPQ-31	Canoga
	C-Band	FPS-16	RCA (Existing)
Data Processing System	Radar to TTY Converter	165	Milgo
	A/D Converters	4005T & 4005R	Milgo
	P/C Converters	4004	

* Found at Eglin Only.

miles. After processing by conversion equipment, this data is sent via teletype to the Goddard Space Flight Center. In addition, this radar can be used as the controlling source by the acquisition system for pointing the other antennas (FPS-16 and acquisition) when the radar operator signifies, by a valid tracking signal, that the radar is effectively and accurately tracking the capsule.

The FPS-16 radar found at each of these sites has a very narrow beamwidth and is capable of providing very precise tracking data throughout its nominal 500-mile range. Digital data from this radar is converted to a teletype format for transmission via teletype to the Goddard Space Flight Center. Secondary analog data is also sent to Cape Canaveral for antenna positioning via a high-speed data link.

9.3 EQUIPMENT ALLOCATIONS

Table 9-1 lists the major equipments at the sites.

9.4 EQUIPMENT LOCATIONS

Equipment locations at these sites are shown in Figures 9-9 through 9-11.

9.5 SITE ADMINISTRATION

Site administration appears in chart form in Figure 9-12.

9.6 GEOGRAPHIC AND CLIMATIC DATA

9.6.1 White Sands

White Sands, New Mexico, is located approximately 45 miles north of El Paso, Texas (Figure 9-8). El Paso is the city in which one is most likely to reside if assigned to the White Sands site, although Las Cruces and Alamogordo are convenient to the site. El Paso is an international border town with a population of over 280,000.

The temperature is mild and the air dry. The average temperature ranges from 43.6°F in January to 79.7°F in July. The average annual rainfall is 7.83 inches and the humidity is extremely low. There are sandstorms during the spring of the year. The area has been named the "Sunland" area.

9.6.2 Eglin

The Mercury site is located at site A-20 of

the Eglin Gulf Test Range (Figure 9-10). Eglin is located in an area which is known as the "Playground". This includes the areas of Fort Walton Beach, Shalimar, and Santa Rosa Island. The temperature ranges from a summer high of 108°F to winter low of 14°F. The hot months of the summer have an average temperature of 90°F while the average temperature during the winter months is 55°F. The annual rainfall measures approximately 58 inches with the heavy rainfall occurring from July to September.

There are occasional storms during the months of August, September, and October with the winds reaching hurricane proportions of 120 mph gales.

9.7 TRANSPORTATION AND COMMUNICATIONS

9.7.1 White Sands

There are buses which operate from White Sands to Las Cruces, Alamogordo, and El Paso on an established schedule, and Government buses operate within the range from the administration area to several sites. The recommended method of travel is by private automobile.

The International Airport in El Paso has regularly scheduled flights by American Airlines, Trans-Texas, and Continental. Both Las Cruces and Alamogordo have small commercial airfields.

The area is served by the Santa Fe Railroad in Las Cruces and the Southern Pacific Railroad in El Paso and Alamogordo.

Telephone service is provided to White Sands and the surrounding vicinity by Mountain States Telephone Company.

9.7.2 Eglin

The area is served by Southern Airways, Inc., which has flights to Dothan, Alabama; Columbus and Atlanta, Georgia; and New Orleans, Louisiana. These flights originate at Eglin; two flights inward and two flights outward daily.

There are two intercity bus lines and excellent hard-surfaced highways to all the communities in the bay area. It is recommended that an automobile be used for local travel.

9.8 SITE PERSONNEL FACILITIES AND SERVICES

9.8.1 White Sands

The neighboring city of El Paso, Texas, offers all of the usual necessities and conveniences of everyday living. There are many furnished and unfurnished apartments for rent with the rates being on a par with those of most sections of the U.S. There are numerous motels and hotels with rates that vary upward from $4.00 per day.

El Paso has an adequate number of doctors, several medical centers, and three large private hospitals, which have a total of 633 beds.

There are many recreational opportunities available in the area. Cloudcroft, a two-hour drive from El Paso, offers skiing in the winter. Golf is played all year long. Elephant Butte Dam, near Truth or Consequences, New Mexico, offers boating, swimming, and fishing. There is a symphony orchestra in El Paso. There are two National Parks and two National Monuments within easy driving distance in addition to a number of interesting spots to visit, such as Mexico, Carlsbad Caverns, and the "scenic drive" of El Paso.

There are more than 200 churches representing the major religious denominations normally found in the United States.

9.8.2 Eglin

The housing situation in the area of the "Playground" has been critical in the past, but with the ever-increasing expansion of industry and the testing station at Eglin, there has been an upswing in home construction. One development, for example, lists houses, with three bedrooms, two baths, living room, family room, kitchen, and carport, for sale from $16,500 to $19,500. The number of motels has been increasing also with the number of accommodations listed over 3,000. Half of this number are cottage-type houses which are convenient for family living.

There are three hospitals and a private clinic in the area with a total of 89 beds. The hospitals are adequately staffed. They are making plans for expansion to meet the increasing growth of the area.

Inasmuch as this is a beach resort area, the recreational facilities are primarily those of the ocean and water variety—fishing, boating, swimming, and water skiing. There are also amusement parks and picnic areas located along the beach. Most of the nationally known charitable and social organizations have member clubs in the area. There are two free lending libraries in the area.

Denominations represented in the area are Protestant, Catholic, and Jewish.

Two local broadcast stations serve the area. There are no local television stations but reception from stations in Mobile, Pensacola, and Panama City is considered good.

9.9 MISCELLANEOUS INFORMATION

9.9.1 White Sands

There are no city or state taxes in this area.

Both commercial and savings bank facilities are available in El Paso.

9.9.2 Eglin

There are two commercial banks and one savings and loan institution found in the area.

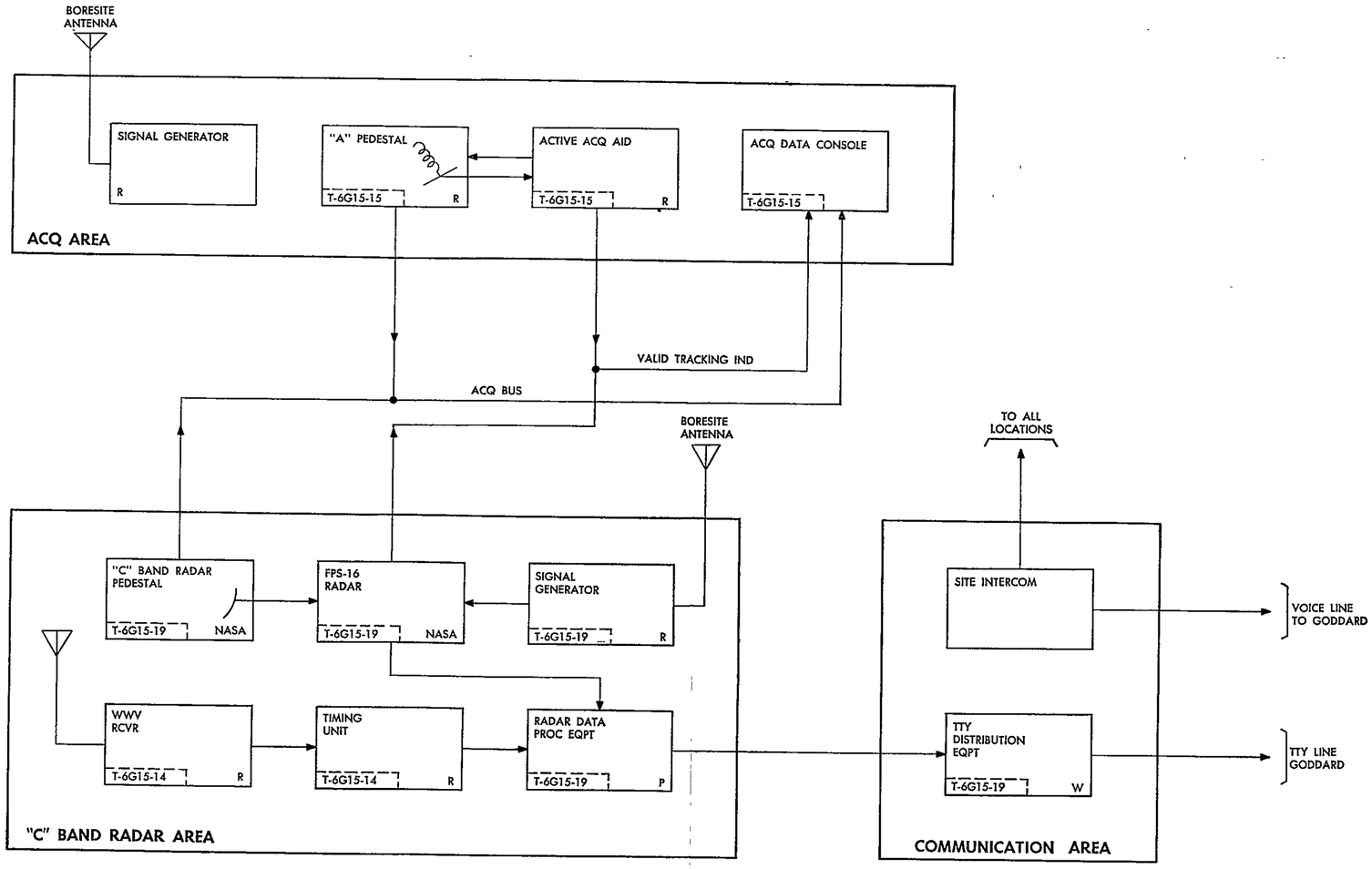


FIGURE 9-1. MASTER FUNCTIONAL BLOCK DIAGRAM— WHITE SANDS

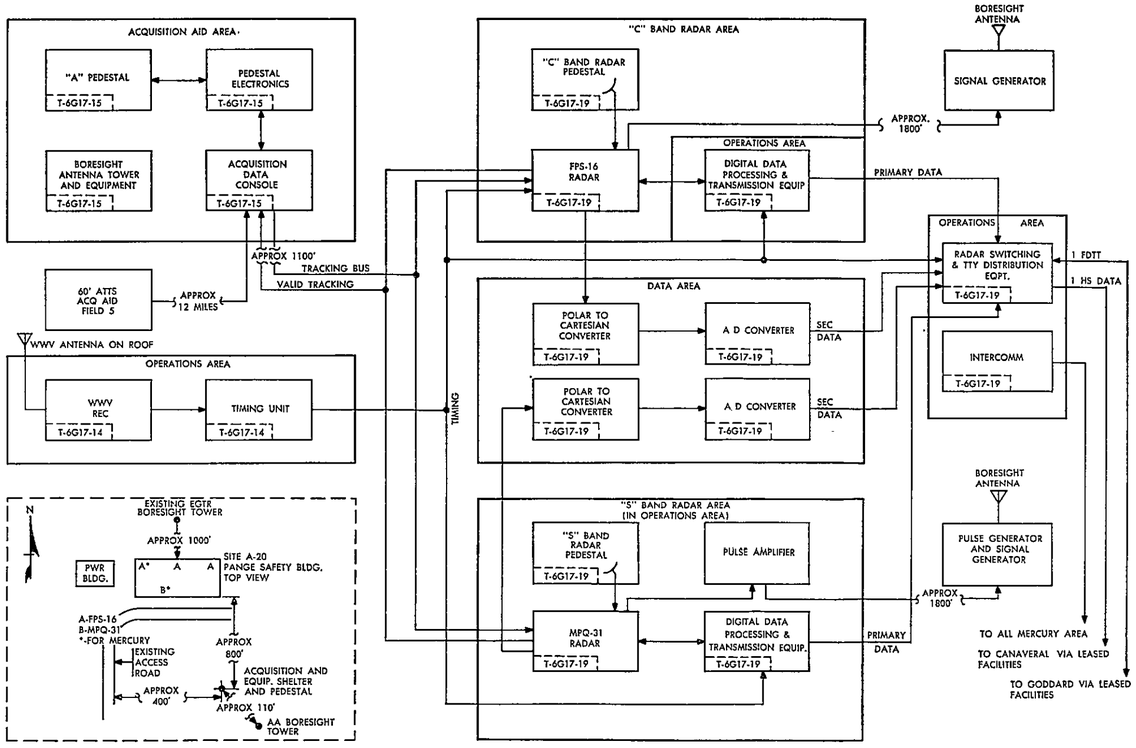


FIGURE 9-2. MASTER FUNCTIONAL BLOCK DIAGRAM — EGLIN

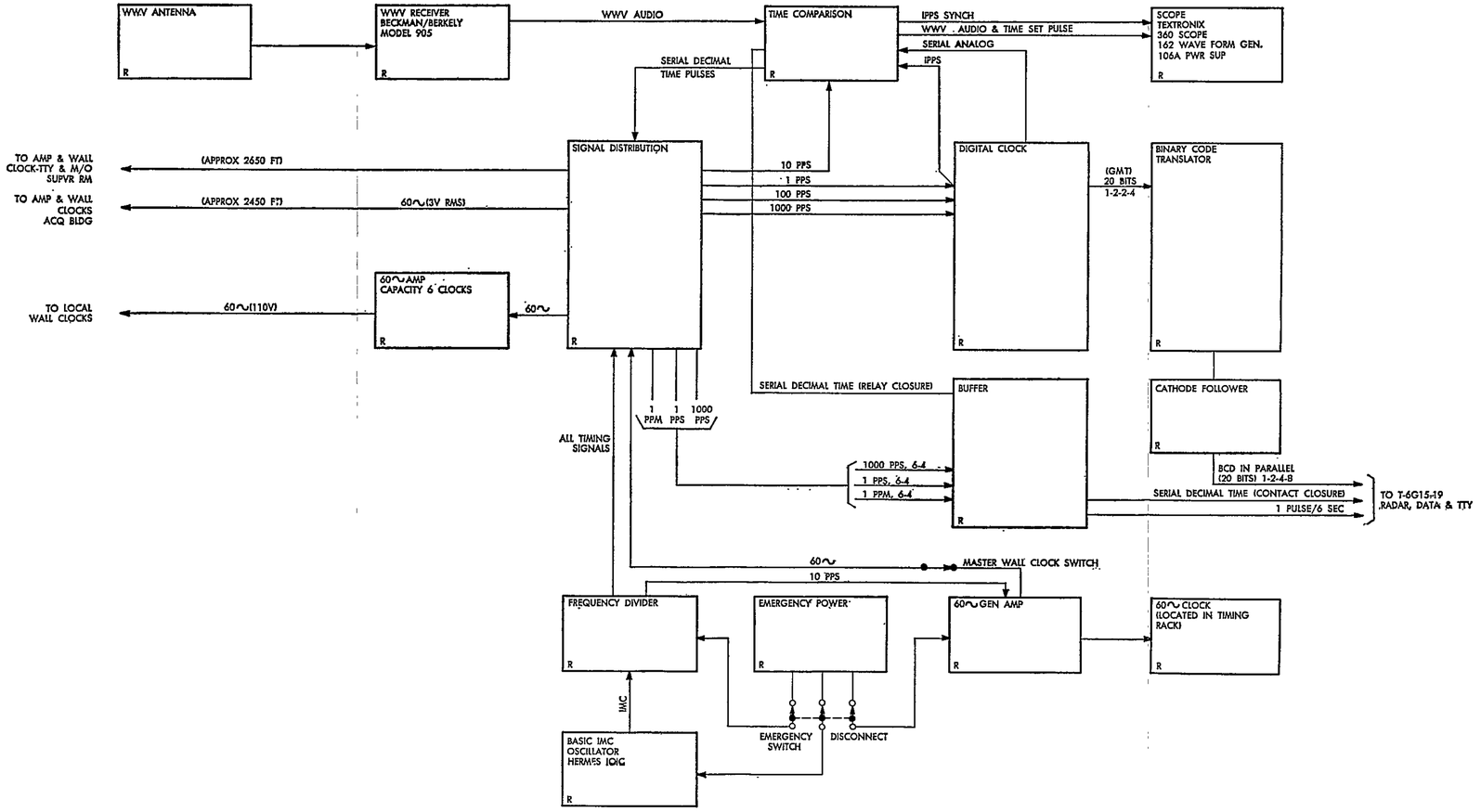


FIGURE 9-3. FUNCTIONAL BLOCK DIAGRAM, TIMING SYSTEM — WHITE SANDS AND EGLIN

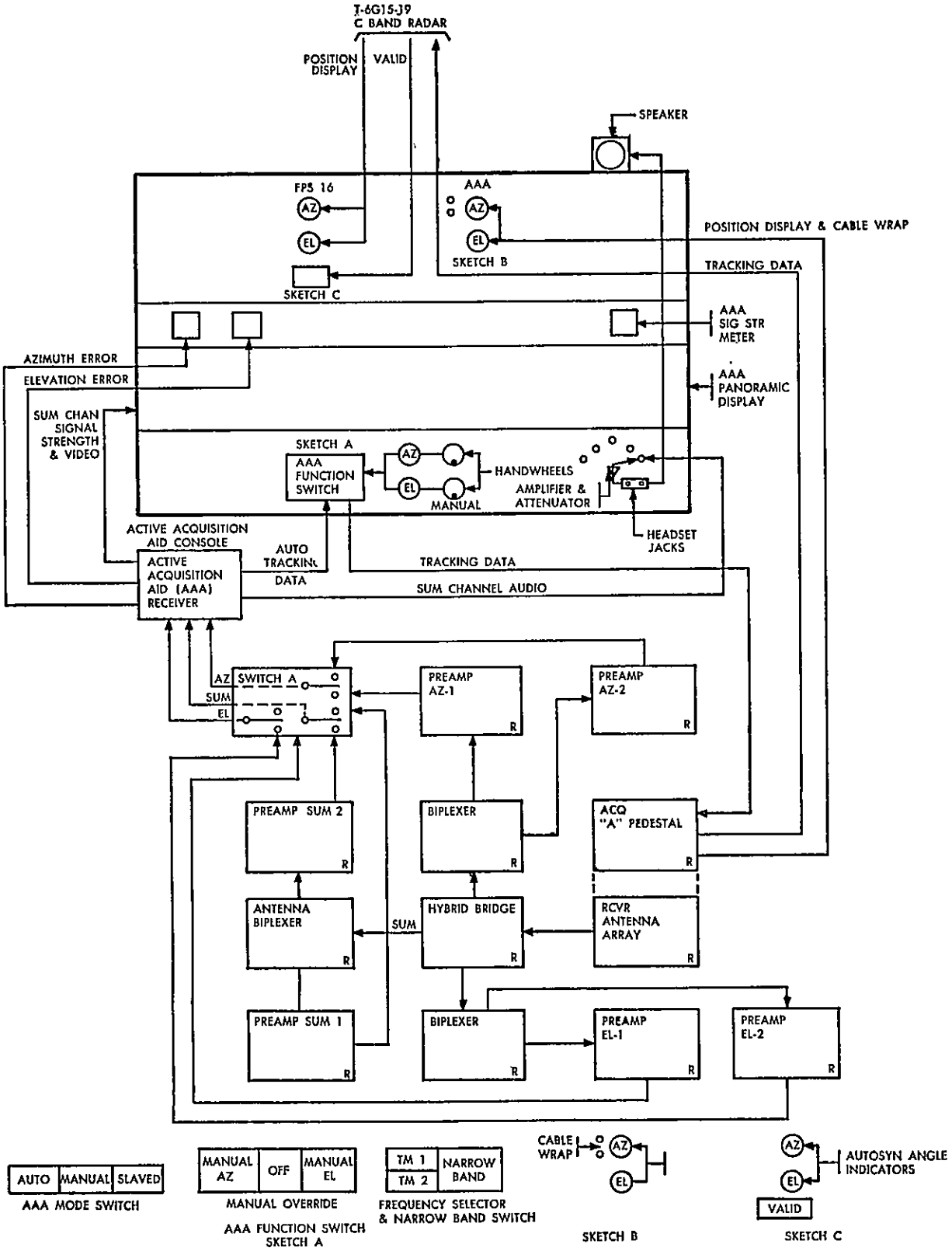


FIGURE 9-4. FUNCTIONAL BLOCK DIAGRAM, ACQUISITION SYSTEM—WHITE SANDS

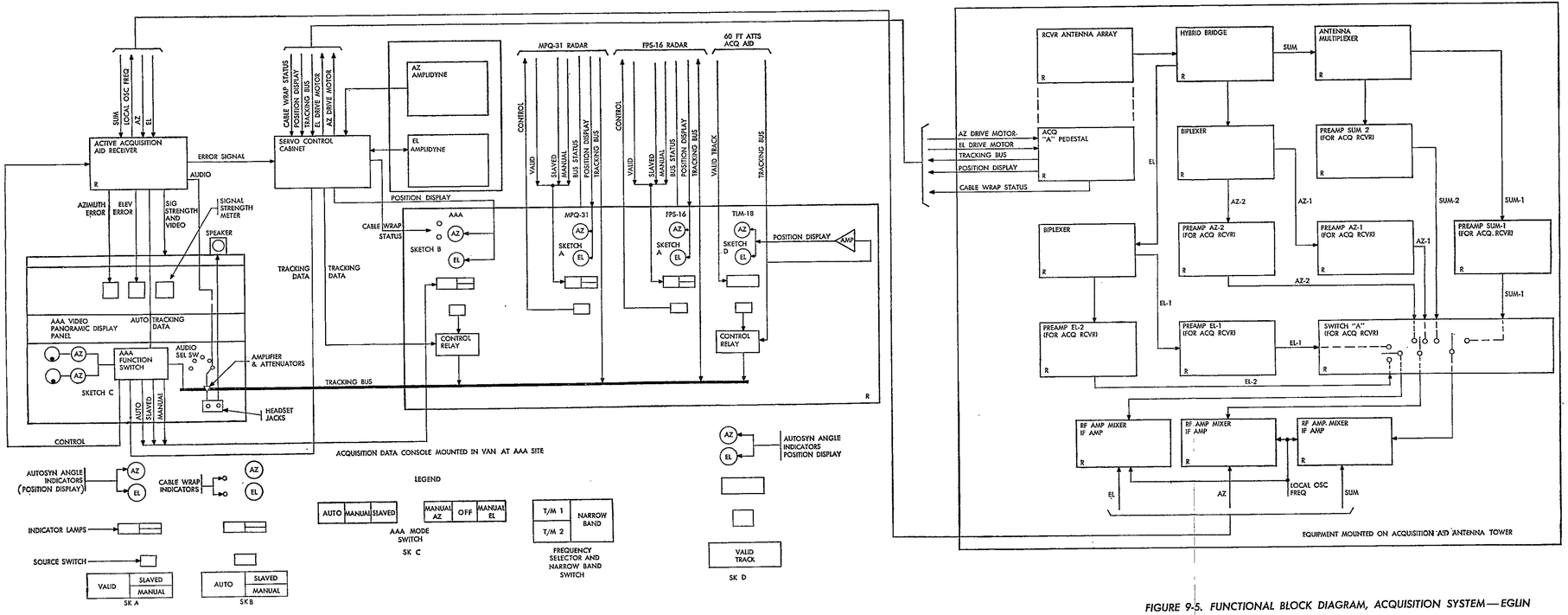


FIGURE 9-5. FUNCTIONAL BLOCK DIAGRAM, ACQUISITION SYSTEM — EGLIN

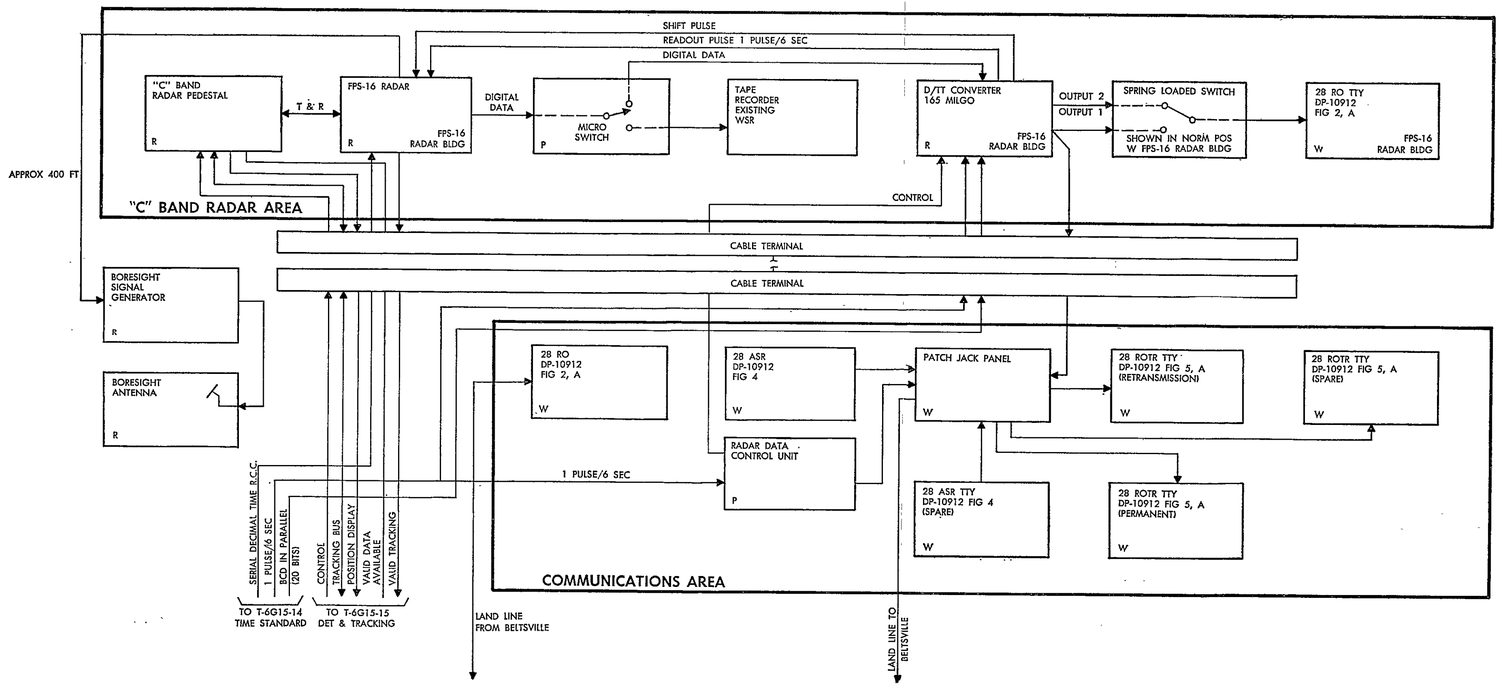


FIGURE 9-6. FUNCTIONAL BLOCK DIAGRAM, RADAR SYSTEM—WHITE SANDS

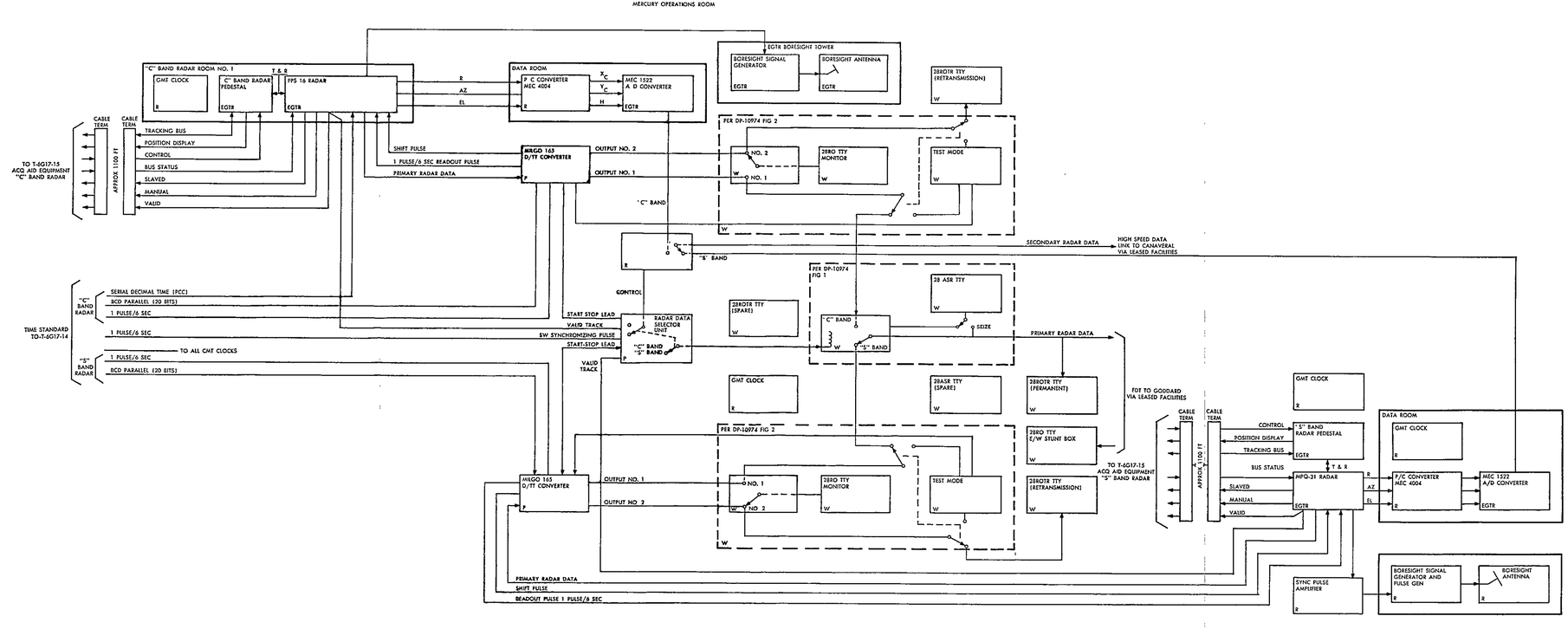


FIGURE 9-7. FUNCTIONAL BLOCK DIAGRAM, RADAR SYSTEM—EGLIN

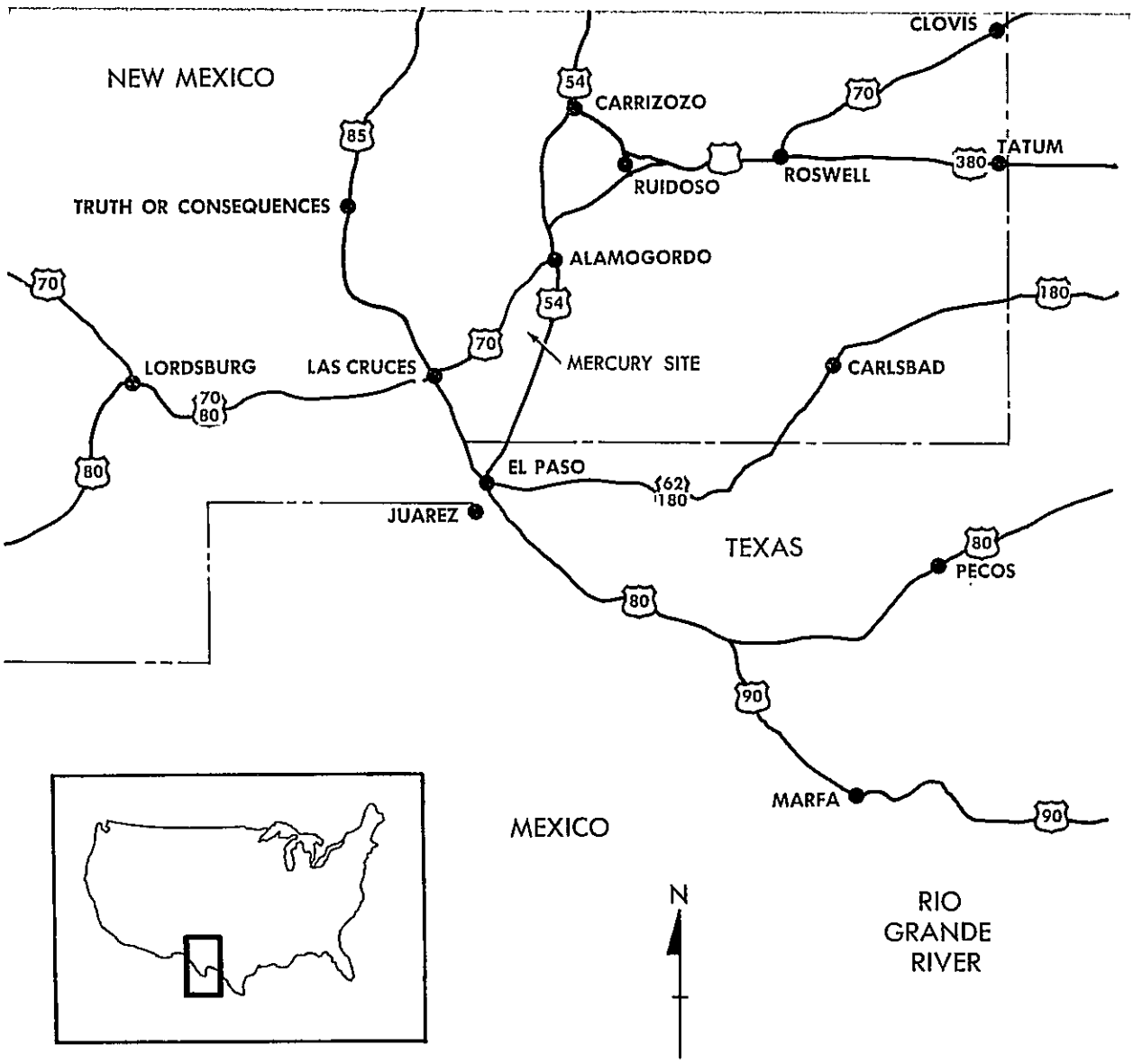


FIGURE 9-8. AREA MAP — WHITE SANDS

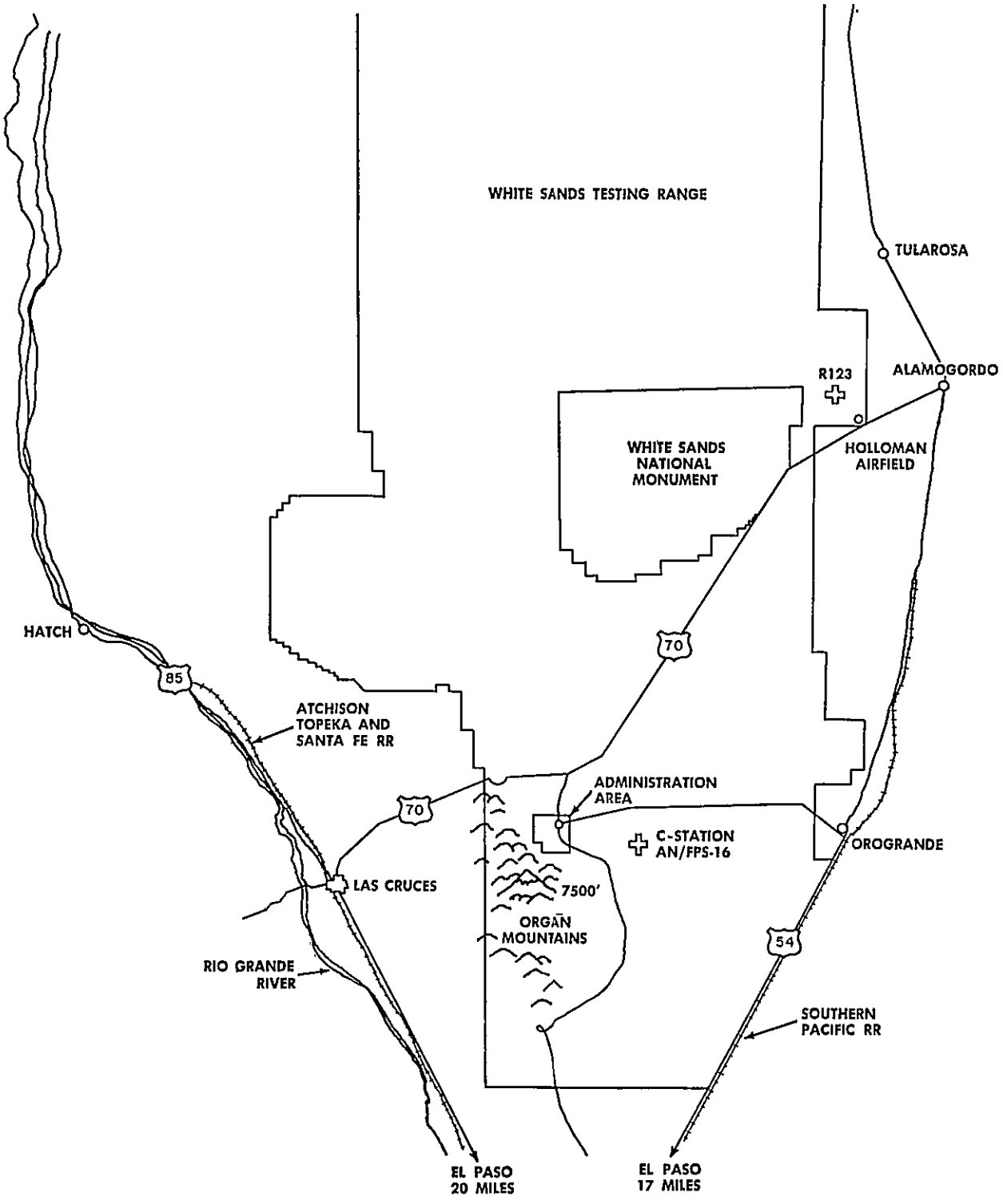


FIGURE 9-9. EQUIPMENT LOCATION — WHITE SANDS

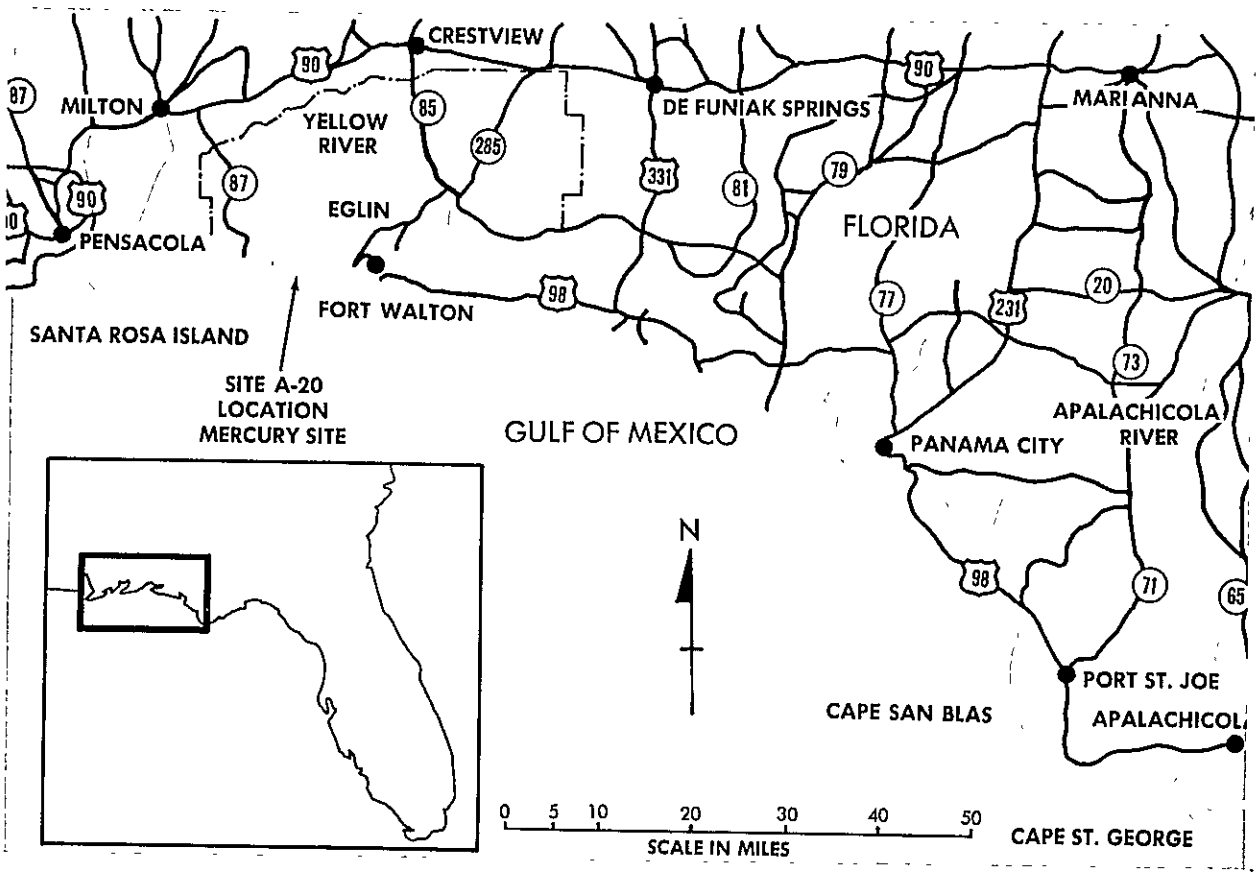


FIGURE 9-10. AREA MAP — EGLIN

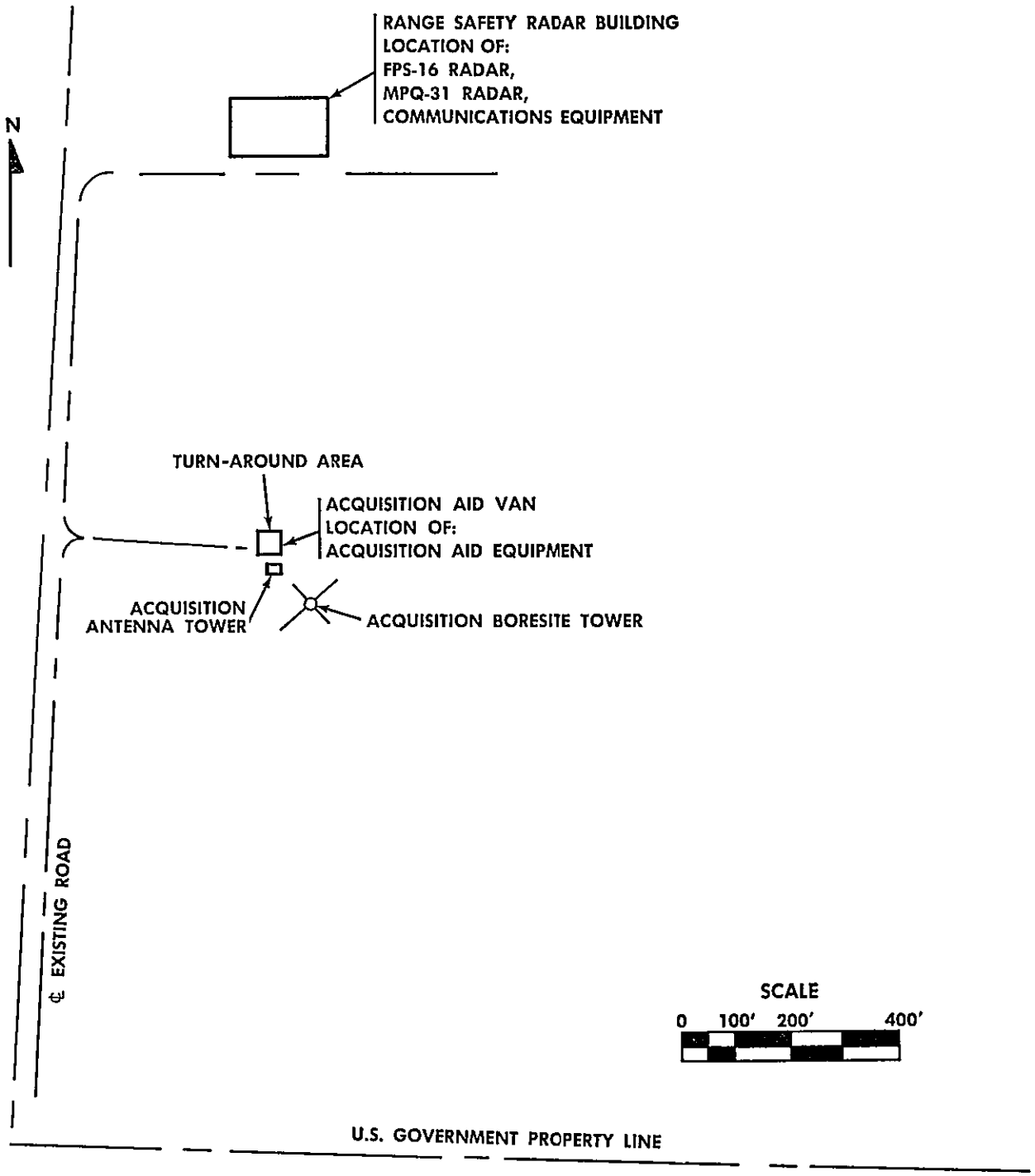
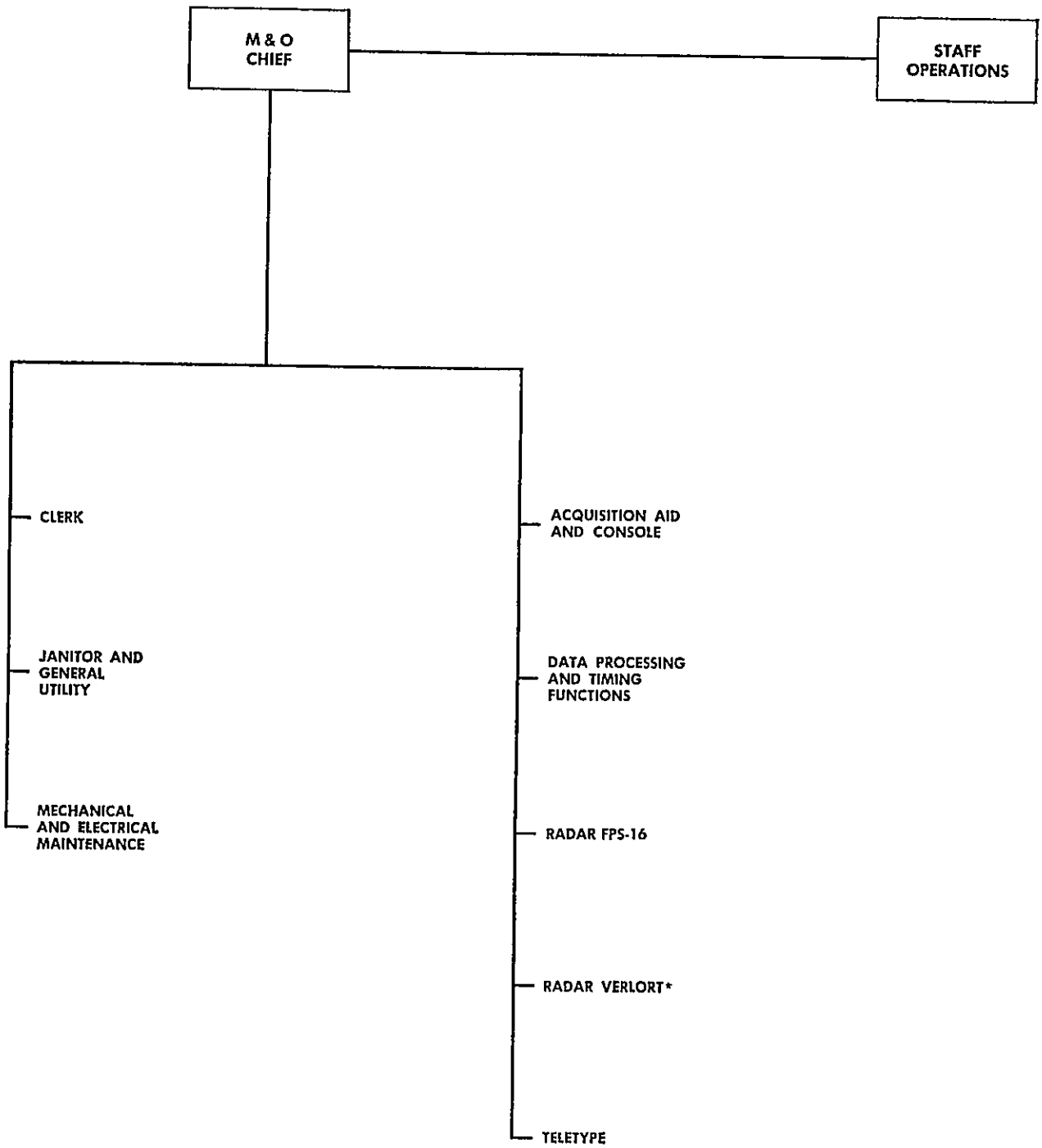


FIGURE 9-11. EQUIPMENT LOCATION — EGLIN



*FOUND ONLY AT EGLIN

FIGURE 9-12. SITE ADMINISTRATION — WHITE SANDS AND EGLIN

Section 10

CANTON ISLAND, KANO, AND ZANZIBAR

TABLE OF CONTENTS

Paragraph	*Title*	*Page*
10.1	Purpose of the Sites	10-1
10.2	Systems	10-1
	Ground Communications System	10-1
	Timing System	10-1
	Acquisition System	10-2
	Telemetry System	10-3
	Capsule Communications System	10-3
10.3	Equipment Allocations	10-4
10.4	Equipment Locations	10-4
10.5	Site Administration	10-4
10.6	Geographic and Climatic Data	10-4
	Canton Island	10-4
	Kano, Nigeria	10-4
	Zanzibar	10-6
10.7	Transportation and Communications	10-6
	Canton Island	10-6
	Kano, Nigeria	10-6
	Zanzibar	10-6
10.8	Site Personnel Facilities and Services (Housing, Medical Facilities, Recreational Facilities, Mail Service, Religious Facilities, Clothing, and Food)	10-7
	Canton Island	10-7
	Kano, Nigeria	10-7
	Zanzibar	10-8
10.9	Miscellaneous Information (Money, Taxes, Visa and Immunization Requirements)	10-9
	Canton Island	10-9
	Kano, Nigeria	10-9
	Zanzibar	10-9

LIST OF ILLUSTRATIONS

Figure	*Title*	*Page*
10-1	Master Functional Block Diagram—Canton Island	10-11
10-2	Master Functional Block Diagram—Kano, Nigeria	10-12
10-3	Master Functional Block Diagram—Zanibar	10-13
10-4	Intercommunication Functional Block Diagram—Canton Island	10-14
10-5	Intercommunication Functional Block Diagram—Kano, Nigeria, and Zanzibar	10-15
10-6	Functional Block Diagram, Acquisition System — Canton Island; Kano, Nigeria; Zanzibar	10-16
10-7	Functional Block Diagram, Antenna Systems—Canton Island; Kano, Nigeria; Zanzibar	10-17
10-8	Functional Block Diagram, Telemetry System—Canton Island; Kano, Nigeria; Zanzibar	10-18
10-9	Functional Block Diagram, Air-ground Communications—Canton Island; Kano, Nigeria; and Zanzibar	10-19
10-10	Location, Project Mercury Components—Canton Island	10-21
10-11	Area Locations—Canton Island	10-22
10-12	Floor Plan, Telemetry and Control Area—Canton Island	10-23
10-13	Floor Plan, Transmitter Van	10-24
10-14	Site Location—Kano, Nigeria	10-25
10-15	Area Location—Kano, Nigeria	10-26
10-16	Receiver Installation—Kano, Nigeria	10-27
10-17	Transmitter Area—Kano, Nigeria	10-28
10-18	Floor Plan, Telemetry and Control Area—Kano, Nigeria, and Zanzibar	10-29
10-19	Site Location—Zanzibar	10-30
10-20	Tunguu Receiver Site—Zanzibar	10-31
10-21	Chwaka Transmitter Site—Zanzibar	10-32
10-22	Site Administration—Kano, Nigeria, and Zanzibar	10-33
10-23	Site Administration—Canton Island	10-34

LIST OF TABLES

Table	*Title*	*Page*
10-1	Equipment Allocations — Canton Island; Kano, Nigeria; Zanzibar	10-5

SECTION 10. CANTON ISLAND; KANO, NIGERIA; ZANZIBAR

10.1 PURPOSE OF THE SITES

In addition to the functions and systems noted in Figure 1-1, these sites are necessary because all three sites contact the capsule during the first passage around the world and can verify the condition of the capsule and the Astronaut, allowing a planned reentry to be decided on before the capsule reaches Hawaii. At Hawaii, the retrotimers can be advanced, by the use of command radio, to terminate the flight in one of the designated recovery areas. The Canton Island site contacts the capsule on its first and second orbital passes after an extended flight from its Woomera (Site No. 9) contact. Kano serves as a ground radio relay station for operational data sent from Zanzibar. Zanzibar can also serve as a relay station for the Indian Ocean Ship, should it be unable to communicate through its normal routing of Perth, Australia.

10.2 SYSTEMS

See Figures 10-1, 10-2, 10-3.

10.2.1 Ground Communications System

See Figure 1-3 for a drawing of the worldwide communications network.

Point-to-point high-frequency (HF) radio systems are used for communication from these sites to the Goddard Space Flight Center and Cape Canaveral Control Center by intermediate land receiving stations. A type of transmission known as frequency shift carrier teletype is used. Transmitter output power is 10 kilowatts (10 kw). Radiation is by means of directional rhombic antennas. The transmitting and receiving equipment at Canton Island is operated by the Federal Aviation Agency (FAA) personnel at this location.

Messages from Canton Island are routed through Hawaii where they are processed through line-sharing equipment in common with messages from Muchea, Woomera, and Hawaii (Kauai). Figure 6-5, Section 6, shows this arrangement. Kano, Nigeria, and Zanzibar messages are routed by way of London to the United States, with line-sharing equipment provided at Kano to allow use of the Kano-London facilities by both sites.

Line-sharing equipment is a configuration of teletype tape reperforators, transmitters, sequencing control relays, and associated alarm circuits (provided to indicate malfunction of the equipment). This equipment accepts messages from various sites and stores them until the message destination facilities are idle. Then the equipment transmits the messages on a sequential basis. Spare equipment is provided for backup purposes at sites having this equipment in the event of component failures.

An intercommunication system is provided for operational and administrative messages between Mercury personnel. Figure 10-4 is a functional block diagram of the interconnections between the Capsule Communicator, Aeromedical Monitor, and Capsule Monitor, as well as other circuits between the Maintenance and Operating Supervisor, communications technician console, and various other maintenance and operating personnel locations at Canton Island. Figure 10-5 shows the intercommunication systems at Kano and Zanzibar. It should be noted that the Canton Island system has nine talking paths connected into the local FAA dial-type private branch exchange. Manual type switchboards are provided at the Kano and Zanzibar sites connecting the local exchanges in Kano and Zanzibar. Ultra-high-frequency (UHF) radio is used for communications between site locations at Zanzibar (Figures 10-4, 10-5).

Functions of particular interest in these systems are the ability to:

a. Talk or monitor on the ground-air radio circuit;

b. Talk or monitor on local conference circuits;

c. Talk to the various technicians, independently of operational circuits used by the Flight Controllers.

10.2.2 Timing System

The timing system provides time correlation of data collected from the telemetry system and

provides a driving source for the control area time displays. The time reference used is that of Greenwich Mean Time (GMT) expressed in hours, minutes, and seconds. See Figure 6-6 for a block diagram of a typical timing system.

A receiver is tuned to the frequency of WWV (the Bureau of Standards radio station). The signals received from this station are used as a reference standard against which a stable one-megacycle oscillator is compared and adjusted, so that the frequency of the signal generated by it agrees with the frequency of the incoming signal. This comparison is accomplished at a convenient point in the circuits of the site's timing system, which supplies various output frequencies from 1 kc to one cycle per minute by frequency dividing circuits. A check of the system is provided by a visual comparison on an oscilloscope of the one-pulse-per-second output from the timing system and the once-per-second tone burst of WWV.

Important outputs of this system are as follows.

a. An output, representing GMT in hours, minutes, and seconds, is used in the data processing and data conversion equipment to time-tag radar data and to drive certain time displays.

b. The telemetry data is time tagged for teletype transmission. The time reference is GMT, and delivered in the serial form of a ten-pulse-per-second pulse train.

10.2.3 Acquisition System

The purpose of the acquisition system is to aid the antennas associated with the site subsystem to acquire signals emanating from the capsule. See Figures 10-6 and 10-7.

Proper functioning of the system depends on error voltages. These voltages are developed by measurement of the time difference at which the signal transmitted by the capsule arrives at the different elements of an antenna especially provided for this purpose. The magnitude of these error voltages is greater as the antenna points away from the capsule, and least when the antenna is aimed directly at the source of the signal.

The difference in arrival time of the signal at the antenna elements (phase difference) is measured by a receiver designed for the purpose which is called the acquisition aid receiver. Error voltages developed by the system are amplified and displayed on appropriate meters to aid an operator in manually correcting antenna position until antenna pointing error has been minimized.

Equipment provided at these sites is somewhat different from equipment at other sites in the Mercury range.

The active acquisition aid console usually provided at the Mercury sites is not provided at these three sites. Equipment usually located on this console is rack mounted on adjacent synchro equipment racks, including the acquisition aid receiver, error-voltage indicators, and pertinent switches.

Manual or automatic control of the acquisition aid antenna, is possible with this equipment. These modes of operation are defined as follows.

a. Manual operation is control of antenna position with handwheels. Visual indications are provided to show the azimuth and elevation coordinates selected with the handwheels.

b. Automatic operation is control of antenna position by the active acquisition aid receiver without manual assistance. The error voltages described above are used to automatically position the antenna pedestals to keep the antennas pointing at the capsule.

An acquisition data console is provided at all three sites. Handwheels, with associated azimuth and elevation indicators, are provided to allow manual control of antenna positioning voltages applied to all antenna pedestals. Signal strength meters, which indicate the outputs of the four telemetry receivers at each site, are also provided to assist in manual positioning of the antennas from this console. Three pairs of indicators are provided to show the azimuth and elevation of the acquisition aid antenna pedestal, receiver pedestal, and transmitter pedestal.

Cablewrap indicators (lamps on the console) indicate when the antenna rotation is either clockwise or counterclockwise from its midpoint, and toward rotational limits established by the permanent connection of antenna cable

to the antenna. Additional indicators show whether the above pedestals are controlled manually by their operators or by the acquisition system.

Acquisition systems at these sites, therefore, are effectively similar in operation to the systems provided at the sites equipped with fully automatic acquisition aid systems. The additional items necessary to equip these sites with fully automatic acquisition aids (a chopper amplifier and a Schmitt trigger) have been supplied, in addition to the acquisition aid receiver, with a switch that provides full manual control and disables the automatic tracking feature when desired. An additional difference in the system at these sites is the type of antenna pedestal provided. A Canoga No. 8417 pedestal is provided in place of the SCR-584 pedestal used on the standard acquisition aids.

System operation is as follows.
An operator receives an acquisition message which gives the expected coordinates (azimuth and elevation) and the expected time of arrival of the capsule at the site's geographical location. Additional messages are also sent to these sites indicating the expected coordinates, along the orbit, at one-minute intervals after the time of the capsule arrival.

The operator positions the handwheels until the appropriate indicators (AZIMUTH and ELEVATION) show that the antennas are pointed toward the coordinates given in the acquisition message. When the capsule signals are received by the system, and manual corrections of antenna position have been made to obtain minimum error-voltage indication on the appropriate meters, the system is then placed in AUTOMATIC operation. In this operational mode, the antennas follow the capsule position while it remains within radio range of the site. Since the beamwidth of the acquisition system antenna is 20 degrees, the system is capable of acquiring the capsule in the early stages of its pass, and of rapidly refining the antenna position so that maximum quality transmission is realized between the capsule and the sites.

10.2.4 Telemetry System

System operation is as follows.

Two quad-helix antenna arrays, each located on a separate pedestal, are used to obtain both height and space diversity (Figures 10-7 and 10-8). Four receivers are arranged in two pairs, with each pair tuned to one of two selected frequencies in the 225-260 megacycle band. The outputs of each pair of these receivers are fed into a diversity combiner, a device which effectively adds the signals and improves the apparent signal-to-noise ratio. The outputs of the diversity combiners (two are supplied for the system at each site) plus the four basic output signals from the above receivers provide six possible sources of information. These are fed to the telemetry demodulation equipment where a manual selection is made of the signal to be demodulated. A spectrum analyzer is employed in selecting the best source of information obtained from the above equipment. These system refinements add greatly to the overall system reliability.

The received signal is complex in nature, containing three channels of frequency-modulated information, plus a fourth channel that is modulated on what is termed a commutated basis, in which various information obtained by sensors in the capsule is sampled on a sequential basis.

Selected data from the above equipment is routed to various displays for monitoring during the capsule pass, and the output of each receiver and diversity combiner is recorded for a permanent record. Approximately 20 quantities and notations, derived from the telemetry signals observed during the capsule transit are incorporated into a standard format and transmitted by teletype to the Goddard Space Flight Center after the capsule has passed.

10.2.5 Capsule Communications System

The air-ground communications facilities at these sites use high-frequency (HF) and ultra-high-frequency (UHF) voice receiving and transmitting amplitude modulated (AM) equipment. See Figures 10-7 and 10-9.

Receiving antennas are mounted on steerable pedestals under control of the acquisition system, as described in paragraph 10.2.3. The UHF signals are received on the same quad-

helix antenna arrays used for telemetry signal reception. The HF signals are received by separate dipole antennas mounted on the same pedestals as the UHF antennas.

The UHF receiver outputs are fed to a diversity combiner where the signals are combined to add their output strength and minimize noise. Three output signals are available: receiver No. 1, receiver No. 2, and the composite signal derived from the diversity combiner. These signals are then fed to the communications technician console HF-UHF selector switch for application of the best signal to the site intercom.

The HF receiver outputs are normally processed by a diversity relay actuator which automatically selects the stronger of the incoming signals. This signal is then compared with the UHF signal at the communications technician console, where the better signal is selected for application to the flight controller air-ground receiving network. The HF receiver outputs are also brought out directly to the communications technician console, bypassing the HF diversity relay actuator, where either receiver output can be selected as previously described.

All voice communication with the capsule is recorded for future reference.

The transmitting antennas are mounted on a steerable antenna pedestal under direction of the acquisition system as previously described. Both HF and UHF transmitters can be keyed (or operated) either individually or simultaneously.

10.3 EQUIPMENT ALLOCATIONS

Table 10-1 lists major equipments grouped by system and the manufacturer or source from whom the equipment is obtained.

10.4 EQUIPMENT LOCATIONS

The Mercury equipment locations are designated on Figure 10-10 through Figure 10-21.

10.5 SITE ADMINISTRATION

Site administration for Kano and Zanzibar is shown in chart form in Figure 10-22. Site administration for Canton is shown in chart form in Figure 10-23.

10.6 GEOGRAPHIC AND CLIMATIC DATA

10.6.1 Canton Island

Canton Island is located in the South Pacific Ocean (Figure 10-10) and is one of the Phoenix Island group. The location of the Mercury site is approximately at latitude 2°48′ S, and longitude 171°40′ W. The island is a typical coral atoll with a few coral reefs in the lagoon, and no barrier reefs. Maximum elevation of 15 to 20 feet is reached within 100 feet of the ocean with a gentle slope to the lagoon. The island is under joint administration of the United States and the United Kingdom and is used by the FAA Weather Bureau, Qantas Airlines, and the Standard Oil Co. The western portion of the atoll immediately south of the channel entrances is now the site of the British Residency, British Post Office, and supporting native colony.

Canton Island lies close to the equator and there are no appreciable seasonal variations in temperature. The normal maximum temperature is 89°F, and the normal minimum is 78°F, with a mean annual temperature of 84°F. Extremes are 98°F high and 70°F low. Humidity ranges from 65 percent during the day to 80 percent at night. Annual rainfall is 20 inches. The maximum rate on record is 5.08 inches in 24 hours. The season of heavier rainfall is usually from April through August inclusive, but this has varied. The heaviest rainfalls have been known to occur from December through March. Heavy storms occur about every 5 years. Hurricanes, typhoons, and monsoons are not considered possible in this area because of its proximity to the equator.

10.6.2 Kano, Nigeria

Kano, Nigeria is one of the largest cities in Nigeria and is situated in the northern region of the country. Nigeria is on the west coast of Africa (Figure 10-14). Geographical coordinates are approximately latitude 11°58′ N, longitude 8°27′ E. The two locations at this site are called the Dorayi Receiver Site and the Post and Telegraphs Site. The Dorayi location is 6 miles from the center of Kano, and the Post and Telegraphs location is 2 miles from Kano. Temperatures vary from 55° to 105°F with rela-

TABLE 10-1

EQUIPMENT ALLOCATIONS — CANTON ISLAND; KANO, NIGERIA; ZANZIBAR

System	*Equipment*	*Type or Model*	*Supplied By*
Acquisition	Active Acquisition Aid		Cubic
	Acquisition Data Console		Bendix Radio
	Synchro Remoting System	Electrospan	Bendix Pacific
Timing	Time Standard Rack		Bendix Radio
Telemetry	Preamplifiers	PR-203	Nems-Clarke
	Receiver	1412	Nems-Clarke
	Receiver	1434	Nems-Clarke
	Diversity Combiner	DCA-500	Nems-Clarke
	Decommutators 90/90	TDS-90	Arnoux
	Descriminators	TDA-102	Bendix
	Tape Recorder	FR-114	Ampex
Displays	Capsule Communicator		Bendix
	Aeromedical Observer		Bendix
	Capsule Observer		Bendix
Ground Communications (At Canton, this system is provided by the FAA)	HF Transmitter	GPT 10K	TMC
	Transmitting Dissipator	TER 5000	TMC
	Dual Diversity Receiver	DDR-6	TMC
	Antenna Multicoupler	HFD	TMC
	Multiplex	T/S 101 & 102	Telesignal
	Rhombic Antenna	RS 330	Wind-Turbine
Air-Ground Communications	HF Transmitter	CS-2029	Gates
	Microphone Amplifier	M 5167	Gates
	Preamplifier	PR 2035	Nems-Clarke
	HF Receiver	R390A/URR	Collins
	Communications Technician's Console	BXR-CTC 500	Bendix Radio
	UHF Transmitter	GRT-3	Radio Receptor
	UHF Receiver	R278B/GR	Collins

tive humidity ranging from 12 percent to 90 percent. A more or less continuous dust storm prevails for four to six months of the year, usually from November to March, because of the dust-carrying winds from the desert regions to the northeast. Winds from the ocean to the southwest bring rain from April to October. Disturbances in spring bring monsoons with winds reaching to 120 miles per hour in gusts. These usually occur during January, February, and March.

Specific climatic information is as follows:

	Summer		*Winter*	
	Max.	*Min.*	*Max.*	*Min.*
Temperatures	106°F	66°F	96°F	46°F

The average annual rainfall for the past 46 years has been 33 inches. The maximum rate of precipitation is 3.2 inches per hour. Most of the rainfall occurs in thunderstorms of three- to

four-hours duration. The dry months are from November to March, the wettest months are from June to September.

10.6.3 Zanzibar

Zanzibar is an island off the southeast coast of Africa (Figure 10-19). Approximate geographical coordinates are latitude 6°12′ S, longitude 36° 21′ E. Two locations are used for this site. The receiver site is located at Tunguu, 11 miles from the city of Zanzibar. The transmitter site is located at Chwaka, 17 miles from Zanzibar. Both sites are relatively flat, with sparsely grassed plains, and are practically without trees. The island has many outcroppings of solid coral in these areas.

Following is a summary of the climatic conditions in the area.

	Summer		*Winter*	
	Max.	*Min.*	*Max.*	*Min.*
Temperature	94°F	71°F	85°F	62°F
Humidity	89%	68%	80%	60%

The annual average amount of precipitation is 58 inches. The maximum rate of precipitation for a 24-hour period is 4 inches. The season's heavy rainfall (monsoon) occurs in April and May, and in November and December. Prevailing winds and their velocities are as follows:

December through March: 10 knots, from the northeast

June through October: 10 knots, from the southwest

10.7 TRANSPORTATION AND COMMUNICATIONS

10.7.1 Canton Island

There are no railroads on Canton Island. There is an airport on the island with one main runway 6000 feet long and 150 feet wide, with a 1500-foot overrun at the eastern end. Future commercial use of the main field is questionable. Pan American Airways and Qantas Airline do not have scheduled stops. The FAA is planning to transfer operations to Samoa next year (1961). Irregular service to the island is now supplied by the FAA.

Deep-water docking facilities are available. The dock length is 370 feet, the water depth is 26 feet at mean low tide. There is no scheduled bus service and no car rental agency on the island. The majority of the vehicles are FAA owned and can possibly be utilized for brief official visits. The British Commissioner maintains two small boats for transportation between the Northside and Southside communities.

Communication is by existing FAA facilities.

10.7.2 Kano, Nigeria

Kano airport is 8 road miles from the Post and Telegraphs Transmitter Site, 12 miles from the Dorayi Receiver Site. The next major airfield is at Lagos, 600 miles to the south. There are 42 scheduled flights daily through Kano by Nigerian Airways, Sabena, Air France, British Overseas Airways Corporation, and Royal Dutch Airlines.

Rail Service is provided by the Nigerian Railway Corp. from the port of Lagos to Kano City. Trains leave Lagos daily. The trip to Kano by train normally requires five days. Special arrangements have been made in the past which reduced this time to three days. Transportation to the sites from Kano is provided by bus-type vehicles.

Local and long distance communications are furnished by the British Postal Office.

10.7.3 Zanzibar

Zanzibar airport is 18 road miles from the Tunguu Receiver Site and 25 roads miles from the Chwaka Transmitter Site. It is served by Sabena Airlines and East African Airlines, as is another airfield, 40 air miles west on the mainland at Dar-Es-Salaam, Tanganyika. Connecting flights are available from Zanzibar to Nairobi, which is served by Air France, Air Italia, British Overseas Airways Corporation, and Sabena Airlines, from major cities in Europe.

A rural bus service using covered lorries carrying freight and passengers operates on a highly irregular schedule over most of the island and is used only by the natives. Taxis are available in Zanzibar City at 10 shillings per hour or 46 shillings per day for car and driver. Most of

the drivers understand English. Bus-type vehicles are furnished for site personnel.

Docking facilities are available at Zanzibar for deep-water vessels.

Local telephone communications facilities are provided by the Zanzibar Public Works Department. Telephone service is to East Africa (Tanganyika, Kenya, Uganda) and Pemba only. No telephone circuits exist to London, but there are telegraph circuits to London and Aden, Saudi Arabia.

10.8 SITE PERSONNEL FACILITIES AND SERVICES

10.8.1 Canton Island

There are no hotel accommodations on the island, but Qantas Airlines has a large barracks-type building equipped with 51 beds in two large rooms. Facilities there also include toilets, showers, and washbowls in limited quantities, and were provided primarily for passengers from aircraft stranded overnight. When not required by Qantas Airlines, these barracks can be rented for $5.00 per night. No maid services are supplied. Special housing is supplied for the Mercury site operating personnel. Meals are supplied at the FAA mess hall. The daily charges at this writing are $4.25.

The FAA operates a medical dispensary and a three-bed hospital under a full-time physician, with a full-time registered nurse in attendance. The hospital is equipped for minor surgery, including appendectomies. X-ray equipment is available. Major medical attention, if not of emergency nature, is obtainable in Honolulu. Payment is required for medical services. A dentist visits Canton Island at three-month intervals and stays for two or three days. There are no particular diseases against which one must guard.

Recreational facilities are limited. A small outdoor movie is run twice each week, and is free. A small club is operated by FAA where cold drinks and a bar are available in the evening. Radio music and several game tables for pool, etc., are available here. Fishing is excellent. SWIMMING IS CONSIDERED HAZARDOUS because of the sharks. Radio entertainment is provided from an extensive record and tape collection by a transmitter located on the island on a frequency of 1530 kc. There are no television programs in this area.

Several languages are spoken by the different islanders, but English is generally understood by most of them.

The frequency of airmail service to the island has not been established at this writing.

Open-neck, short-sleeved cotton shirts and shorts are the most common attire, although some long cotton trousers are worn. Cotton baseball-type caps or straw hats are highly desirable due to the intense sun. Pith helmets are not worn on the island. The majority of personnel on the island wear tennis shoes, canvas shoes, or sandals, due to the effect of the coral on conventional leather shoes. Bare arms and legs are no problem in the evening since there are no mosquitoes. Caution should be observed, upon arrival at the island, until tanning precludes excessive sunburn. There are no formal dress requirements on the island.

A commissary is open two days per week with name-brand dry stores, smokers' items, beverages, etc.

Occasional visits of clergy by the FAA airplane provides the island chapel with professional services. Weekly Sunday school is held for all the residents.

10.8.2 Kano, Nigeria

Most housing suitable for Europeans is provided by the employer of the Europeans, and is not, therefore, generally available. The rent for those units that are occasionally available ranges from $70 to $200 per month, furnished. Temporary and semipermanent quarters and eating establishments suitable for Europeans are limited to the Kano Central and Kano Airport hotels, and the Kano Air Terminal Restaurant. The Kano Central Hotel is located in the center of Kano, 2 miles from the Posts and Telegraphs Transmitter Site and 6 miles from the Dorayi Receiver Site. The rooms at this hotel are air-conditioned, while those at the airport hotel are not, for the most part, air-conditioned. Hotel rates range from the equivalent of $3.02 per day to $15.26, the latter price including meals. A dinner in the local hotel costs in the vicinity of $2.50.

Canned foods are 100 percent higher than the U. S. price level. Meats are the same price as in the U. S., but are of poor quality. Locally made clothing is in the same price range as U. S. prices, imported clothing is 50 percent higher. Other items, such as tobacco, liquors, and gasoline, are much higher than in the United States.

Hospital facilities are provided by the Narassawa Hospital and the City Hospital. Doctors and specialists, including a dental surgeon, are available. Surgery is performed locally, and drugs and medical supplies are in good supply. Kano is generally healthy. Mosquitoes are prevalent during the wet seasons and almost nonexistent during dry seasons. Mosquito netting is used at night during the mosquito season. Malaria, dysentery, and hookworms are common to the area but preventive medications are available, such as primaquinine. Bottled water should be used for drinking.

Recreational facilities are provided by the Hotel Kano Club, one mile from the hotel, where tennis, badminton, horse racing, squash, dancing, and a bar are available. There are no television programs at present, but plans are for the installation of a station in the area. The local electrical power supply is 230-volt, 50-cycle AC, requiring modification of appliances brought from the U.S.

Airmail service usually requires one week from the United States and five days to the United States. There are 42 flights daily in and out of Kano in all directions.

English is understood by some natives, although they normally speak Hansa.

Normal tropical clothing is worn in this area, including shorts, etc. Pith helmets are not in style. A raincoat is a necessity.

Religious denominations represented in Kano include Episcopal, Roman Catholic, and Moslem.

10.8.3 Zanzibar

Housing considered suitable for Europeans in the form of apartments and houses is available. All are of masonry construction. The living quarters in Zanzibar Town (the older section) have limited plumbing and electrical conveniences. The living quarters in Mazizini area south of Zanzibar Town are new and have adequate plumbing and electrical conveniences. Many of the latter are government owned. Rental rates vary from $50 to $150 per month.

Temporary or semipermanent quarters considered suitable for Europeans are limited to the Zanzibar Hotel, the Pigalle Hotel, and the English Club. Not all of the rooms at these establishments are air conditioned, and quarters are available for members only at the English Club. Rates are from 35 shillings for basic quarters upward, on the American Plan only (with meals). Food prices are somewhat lower than in the U. S., but foodstuffs are considered of lower quality than the corresponding American items. The social section of the English Club in Zanzibar has a library, billiard room, bar, and dining room. Facilities are also provided for golf, cricket, hockey, tennis, and squash. Swimming, boating, and fishing facilities are excellent. Badminton is played. Equipment for most games is available, but golf clubs should be brought in with the visitor. The electrical power supply is 220-volt, 50-cycle AC.

Tropical clothing is worn all year, but a sweater or jacket is also advised. A good supply of clothing is recommended because of the high humidity, making frequent clothing changes desirable. Dark glasses are useful. Light tropical suits, shorts, or slacks are worn during the day. Summer formal wear is worn at private dinners, or at the club, otherwise dress is a matter of choice. Local shoes are not of good quality; it is usually advisable to bring shoes one half size larger than are worn in the temperate climates. Tailor-made clothes can be obtained locally.

Anglican, Moslem, and Roman Catholic churches are well established in Zanzibar City.

Medical facilities are considered adequate. A government hospital has eight rooms for Europeans, and is staffed by doctors, dentists, and surgeons. Medical supplies are up to date and are readily available. Zanzibar is a mild endemic area for malaria, requiring the use of suppressives by Europeans. Hookworm is common among natives, the majority of whom wear no

shoes. Venereal disease is widespread among the natives. The water in Zanzibar City is considered safe, but bottled and treated water should be used away from this area.

10.9 MISCELLANEOUS INFORMATION

10.9.1 Canton Island

See Figure 1-4 for immunization and passport requirements.

Banking facilities at Canton Island are not known at this writing.

Tax requirements for Mercury personnel at this site have not been determined at this writing, but normal overseas exclusions granted by the Federal Government indicate no financial hardships for personnel stationed in this area.

10.9.2 Kano, Nigeria

See Figure 1-4 for immunization and passport requirements.

The English pound is not legal tender in the Federation of Nigeria, but the exchange rate is the same for the Nigerian pound and the pound sterling. There are 20 shillings to the Nigerian pound, which currently exchanges for $2.80 in United States currency.

Banking houses in Kano include the Bank of West Africa and Barclays Bank D.C.O.

Tax requirements for Mercury personnel at this site have not been determined at this writing, but normal overseas exclusions granted by the Federal Government indicate no financial hardships for personnel stationed in this area.

10.9.3 Zanzibar

See Figure 1-4 for immunization and passport requirements.

The monetary unit of Zanzibar is the East African shilling, which is divided into 100 cents. Twenty East African shillings are equal to one pound sterling, which exchanges for $2.80.

Currency can be transferred to Zanzibar through the normal banking system, that is, by traveller's check, letter of credit, or by bank transfer. Banking houses in Zanzibar are the National Overseas and Grindley's Bank Limited and the Standard Bank of South Africa.

Tax requirements for Mercury personnel at this site have not been determined at this writing, but normal overseas exclusions granted by the Federal Government indicate no financial hardships for personnel stationed in this area.

NOTE

All prices and exchange rates quoted in this manual are current at the time of this printing. It should be kept in mind that they are subject to change, and they should be verified through lines of organization before personnel departure for these areas.

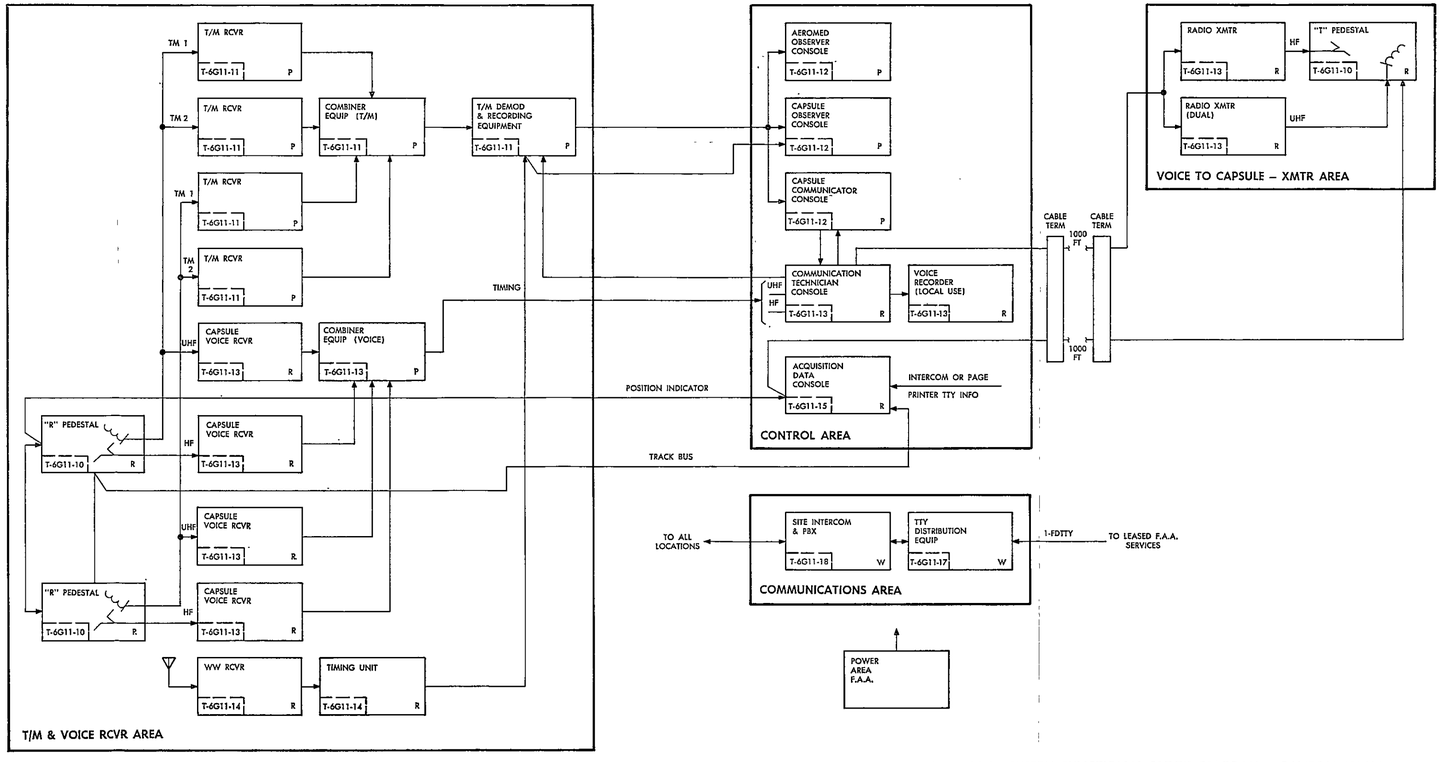


FIGURE 10-1. SYSTEM FUNCTIONAL BLOCK DIAGRAM—CANTON ISLAND

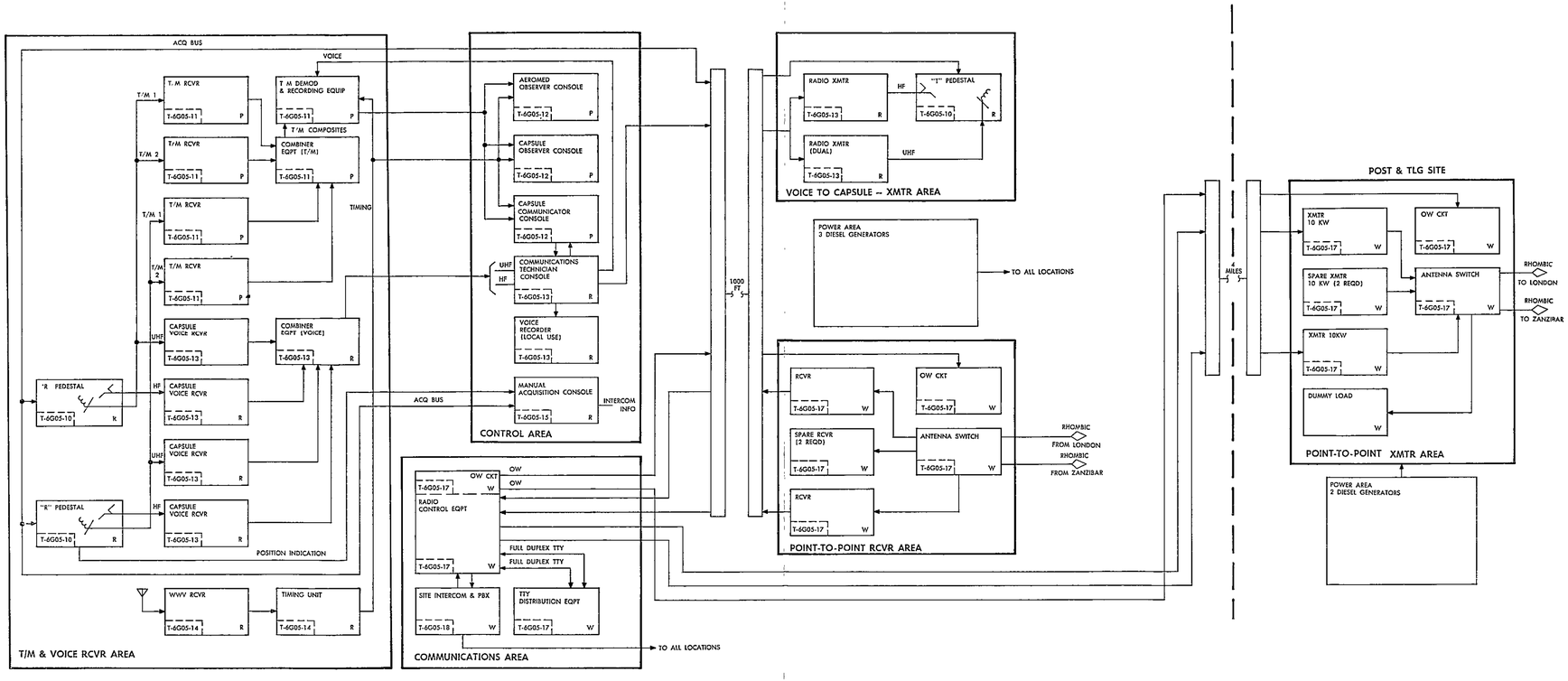


FIGURE 10-2. SYSTEM FUNCTIONAL BLOCK DIAGRAM—KANO, NIGERIA

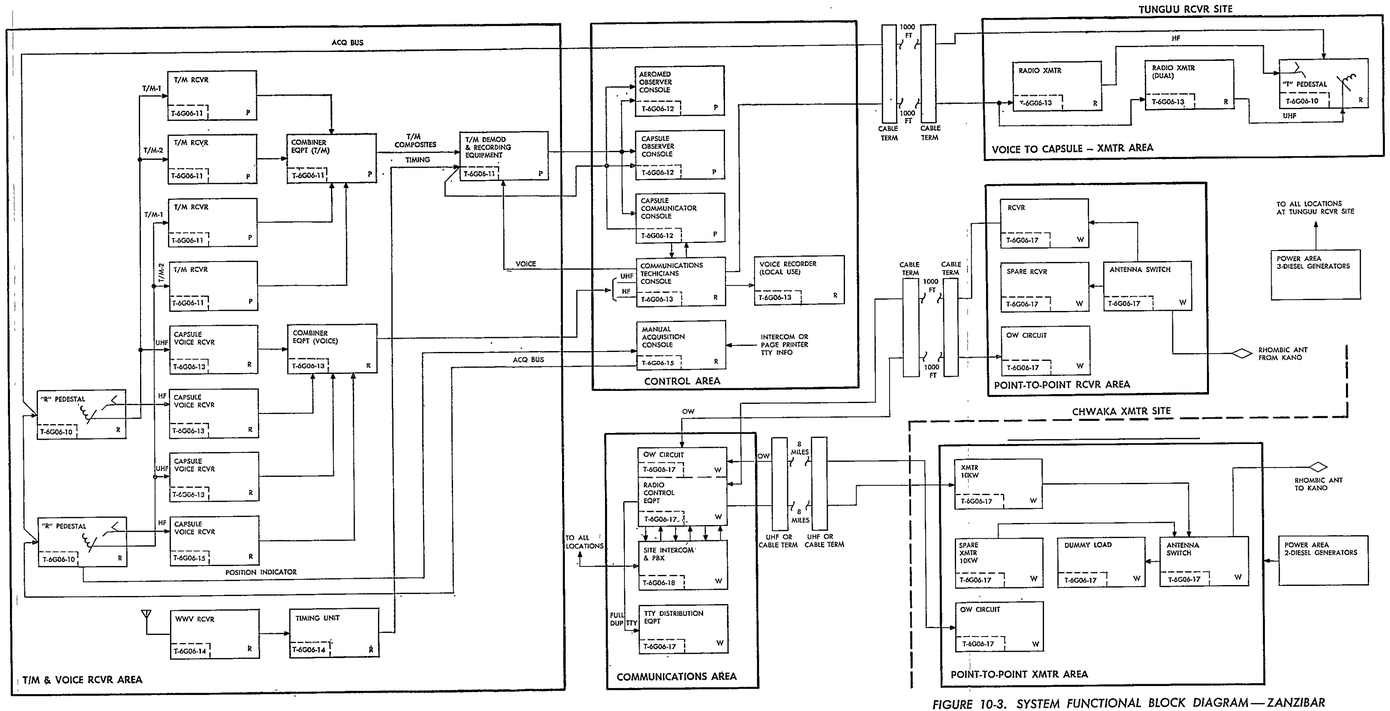


FIGURE 10-3. SYSTEM FUNCTIONAL BLOCK DIAGRAM — ZANZIBAR

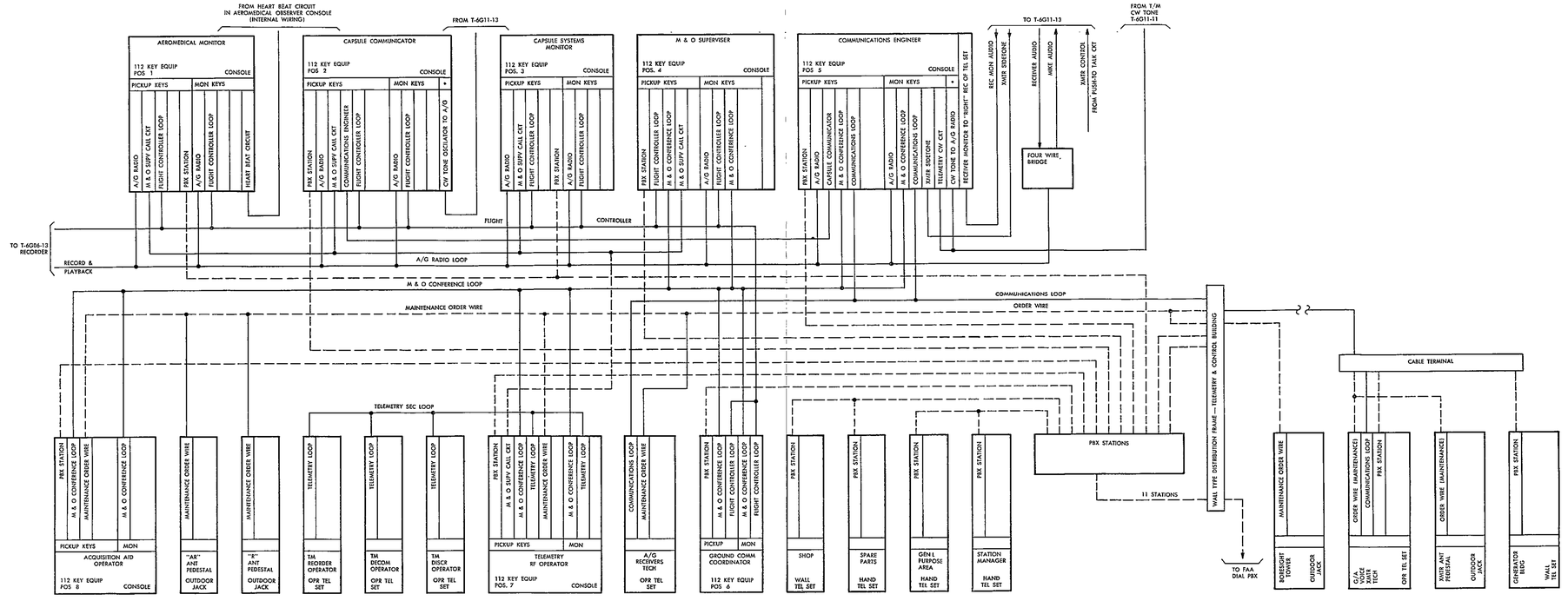


FIGURE 10-4. INTERCOMMUNICATION FUNCTIONAL BLOCK DIAGRAM—CANTON ISLAND

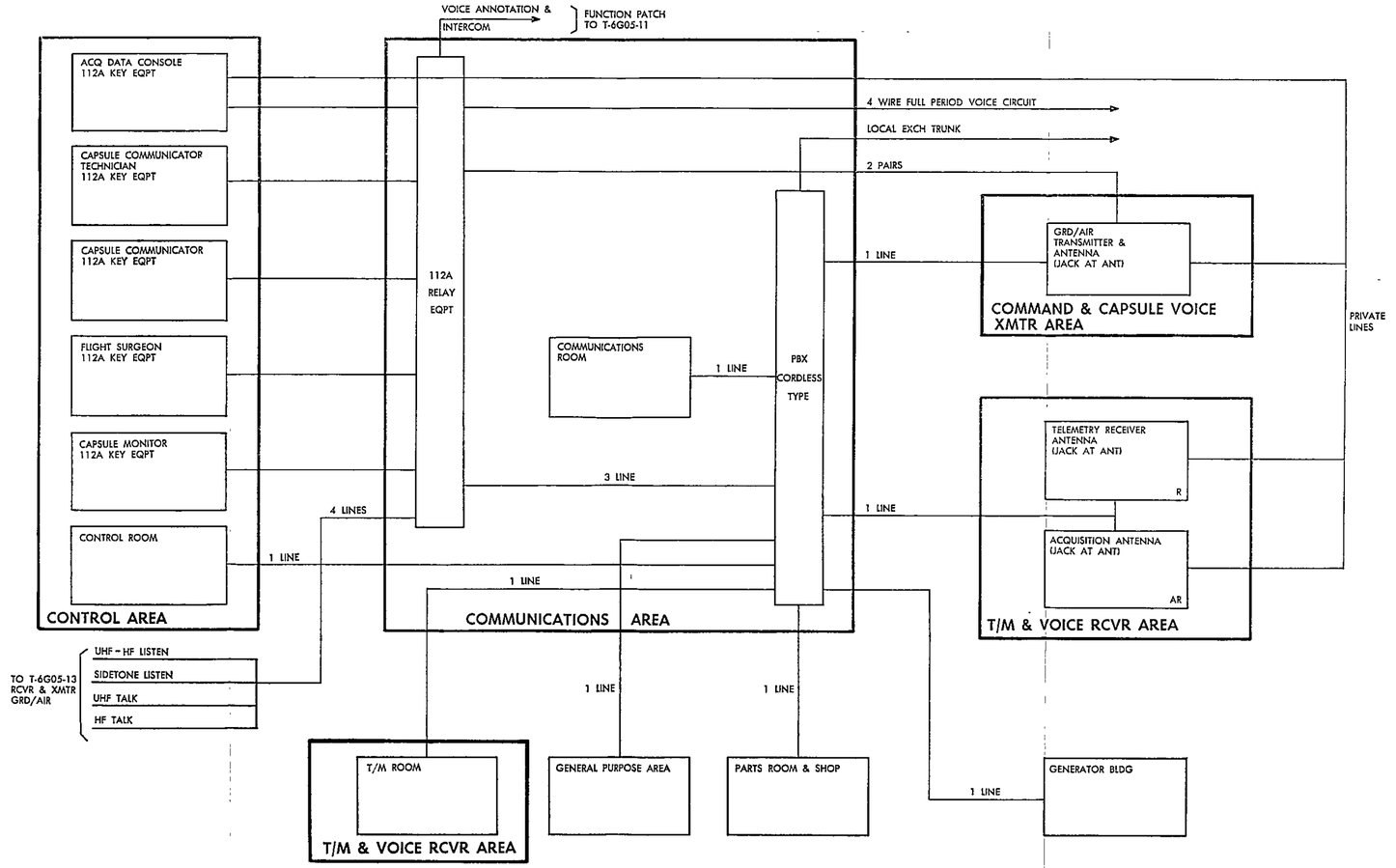


FIGURE 10-5. INTERCOMMUNICATION FUNCTIONAL BLOCK DIAGRAM — KANO, NIGERIA; ZANZIBAR

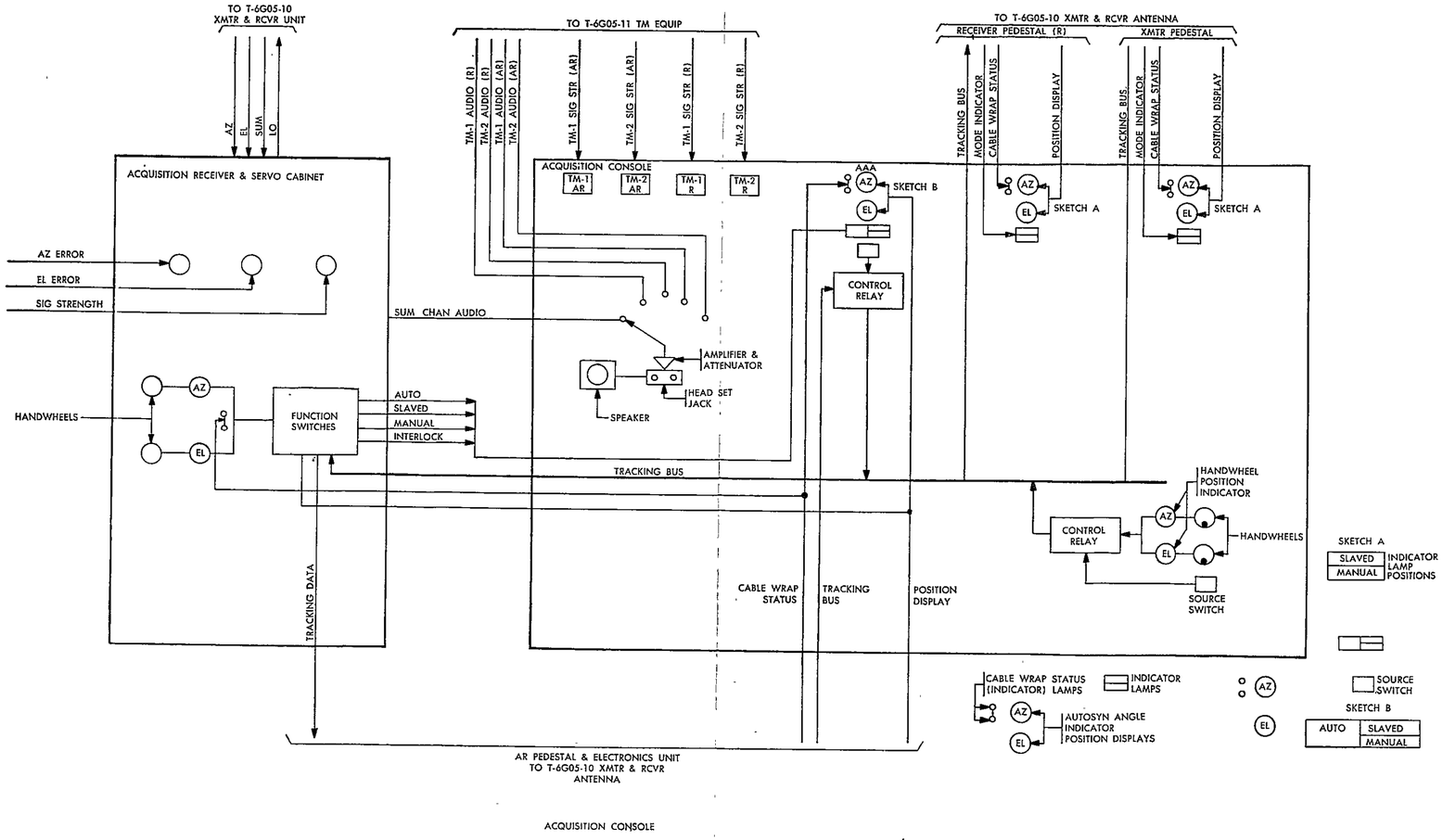


FIGURE 10-6. FUNCTIONAL BLOCK DIAGRAM, ACQUISITION SYSTEM—CANTON ISLAND; KANO, NIGERIA; ZANZIBAR

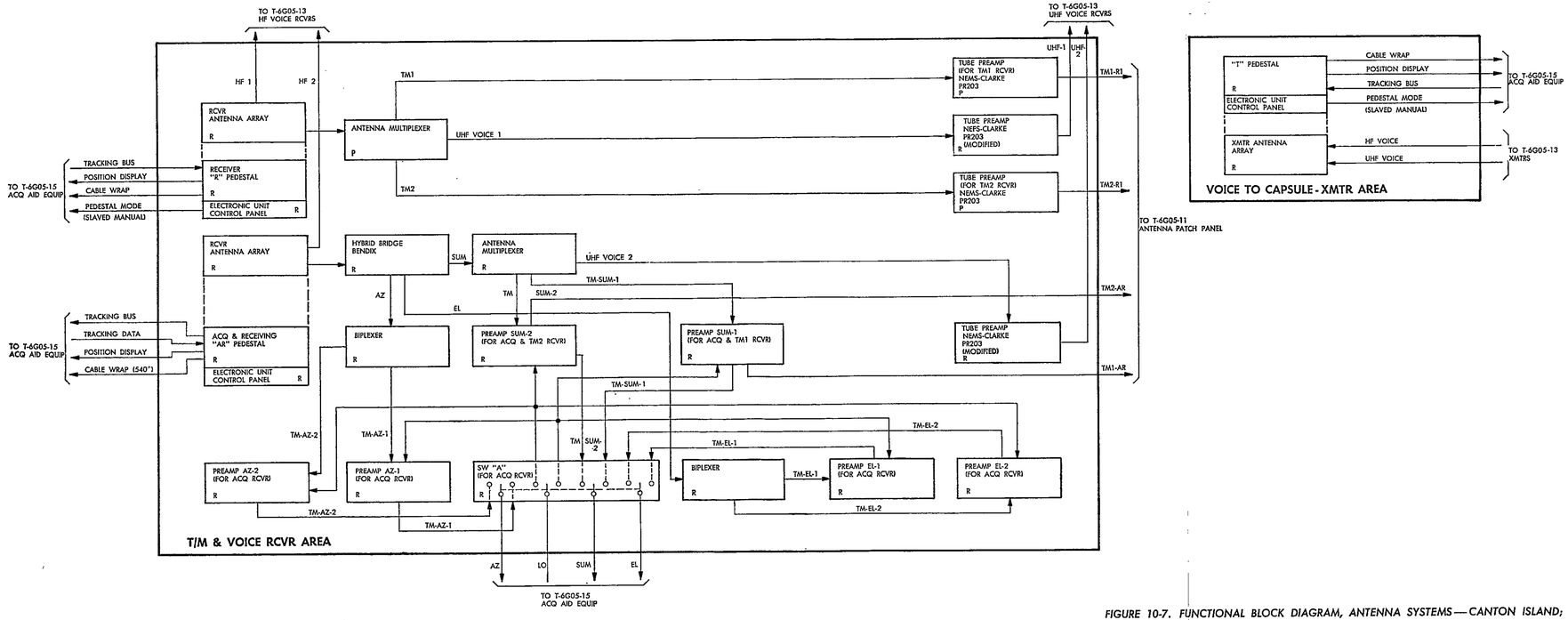


FIGURE 10-7. FUNCTIONAL BLOCK DIAGRAM, ANTENNA SYSTEMS — CANTON ISLAND; KANO, NIGERIA; ZANZIBAR

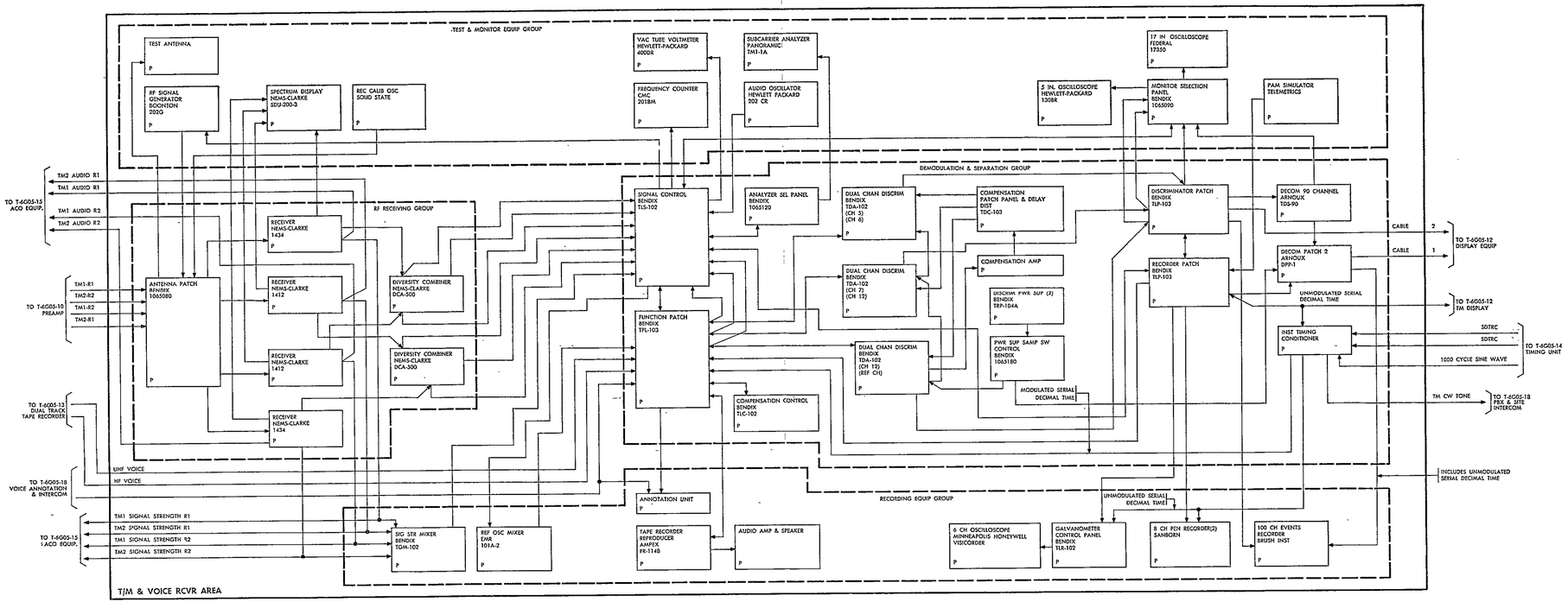


FIGURE 10-8. FUNCTIONAL BLOCK DIAGRAM, TELEMETRY SYSTEM—CANTON ISLAND; KANO, NIGERIA; ZANZIBAR

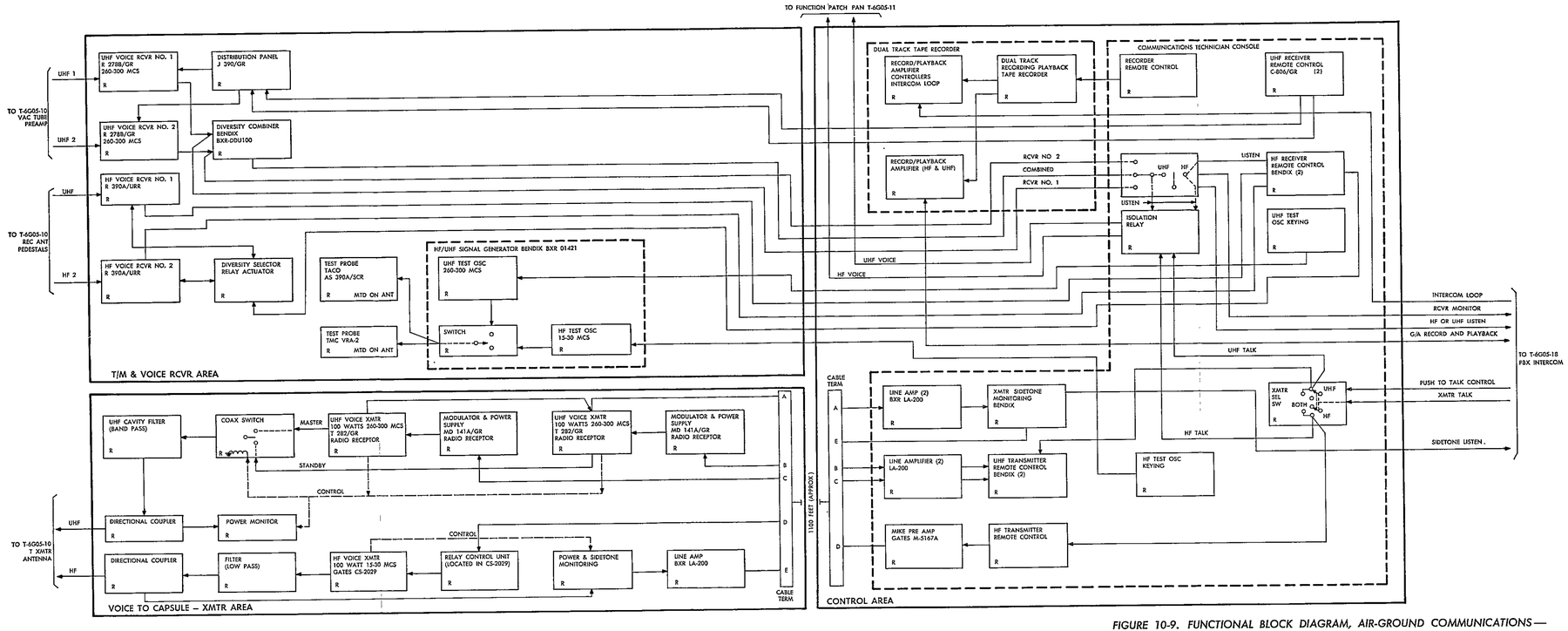


FIGURE 10-9. FUNCTIONAL BLOCK DIAGRAM, AIR-GROUND COMMUNICATIONS— CANTON ISLAND; KANO, NIGERIA; ZANZIBAR

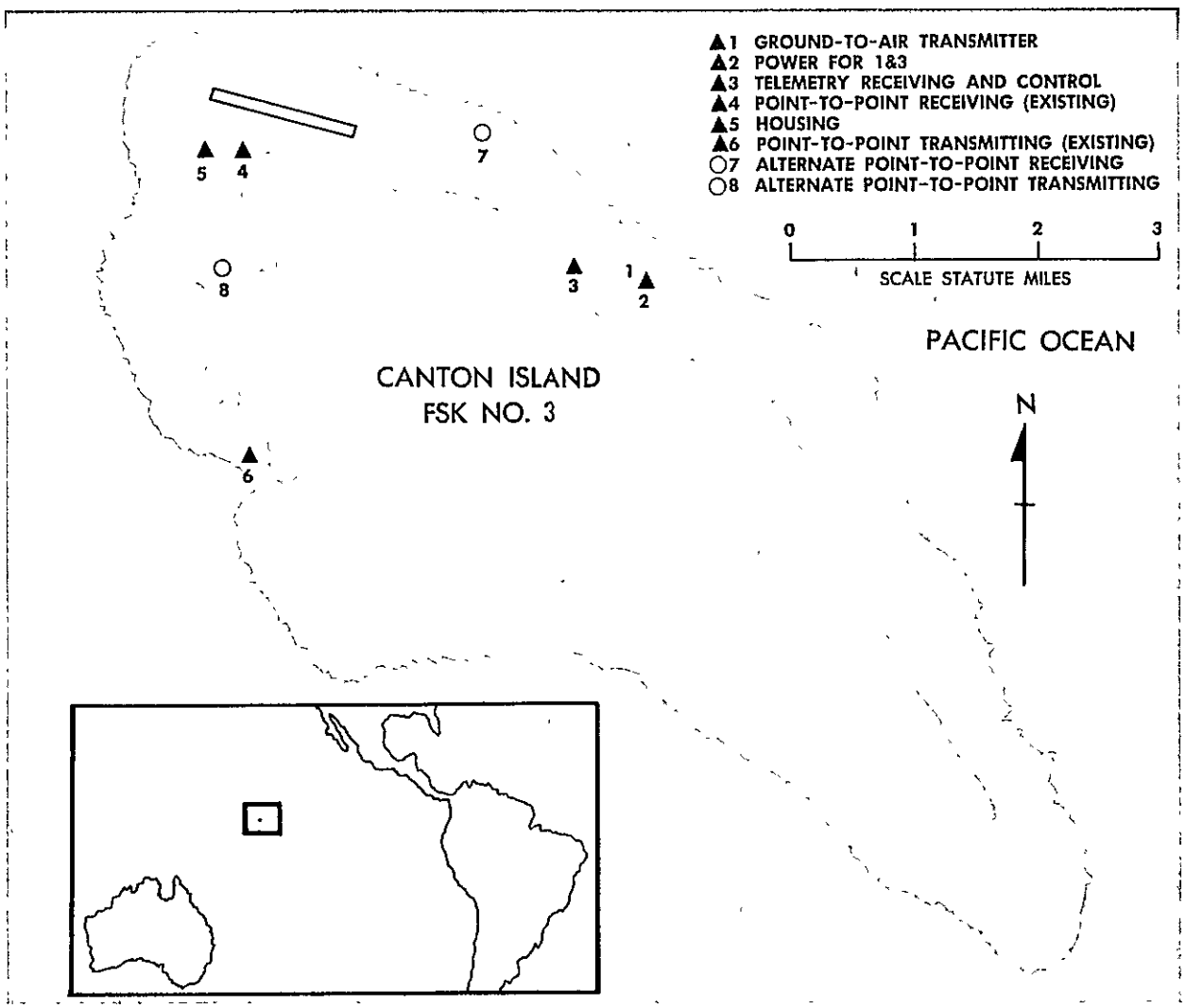


FIGURE 10-10. LOCATION, PROJECT MERCURY COMPONENTS — CANTON ISLAND

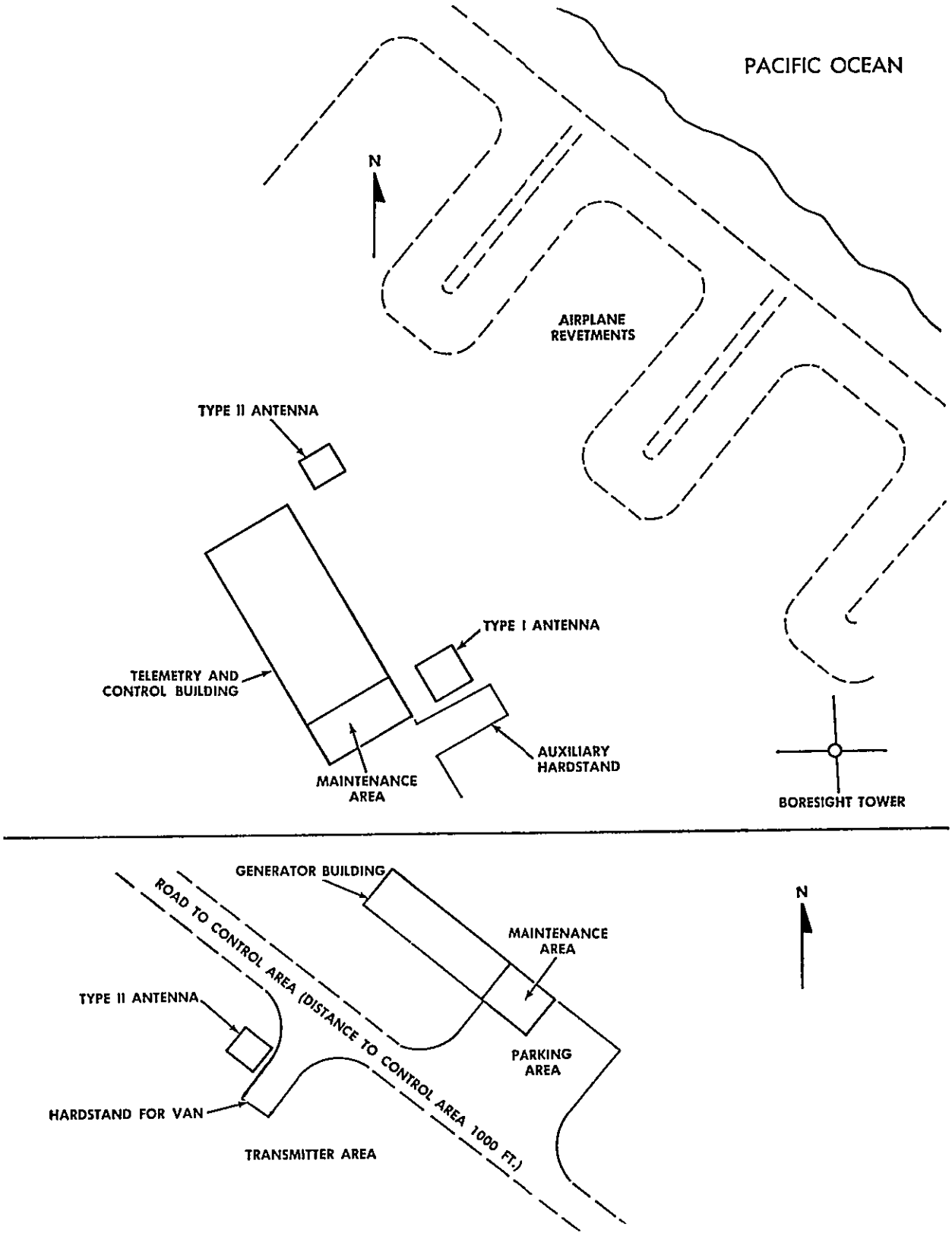
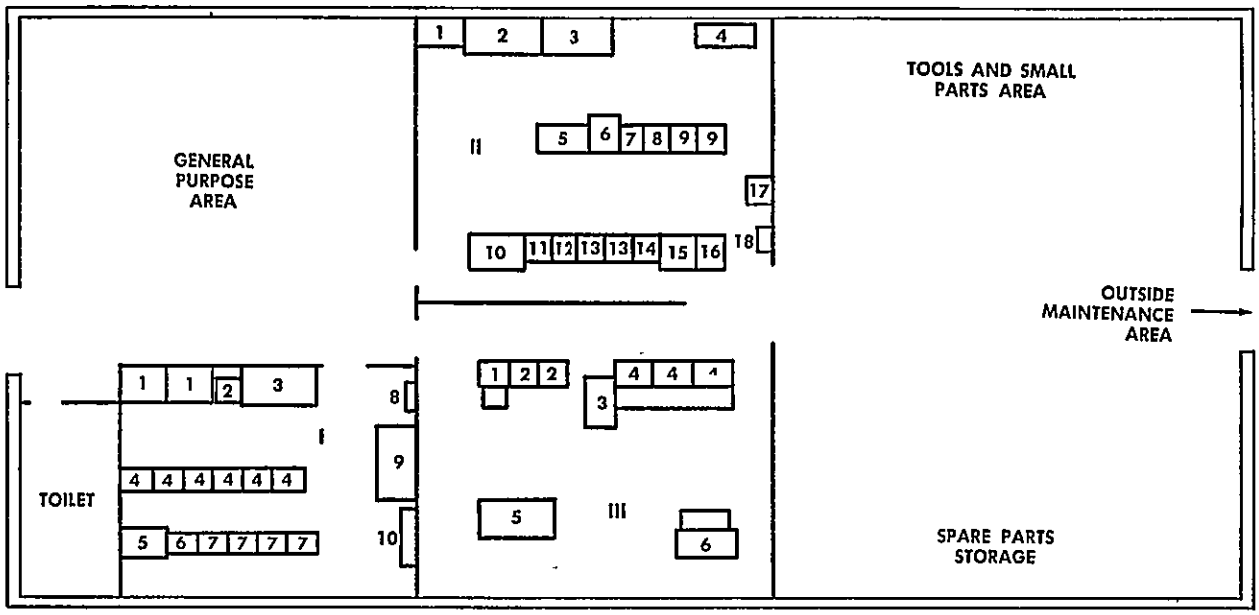


FIGURE 10-11. AREA LOCATIONS — CANTON ISLAND



AREA I

1. 28ASR
2. 28RO
3. DESK
4. 112 KEY EQUIPMENT
5. 105D POWER PLANT
6. MISCELLANEOUS FUSE PANEL
7. 112 KEY EQUIPMENT
8. POWER PANEL
9. WORK BENCH
10. DISTRIBUTING FRAME

AREA II

1. STORAGE CABINET
2. WORK BENCH
3. DESK
4. CABLE TERM. CABINET
5. TIMING STANDARD
6. DECOM MONITOR
7. 90/90 DECOM
8. RECORDER
9. PEN RECORDER
10. VOICE RECEIVER
11. DISCRIMINATOR
12. CALIBRATOR
13. RECEIVERS A AND B
14. CONTROL
15. REPRO PRECISION
16. TAPE RECORDER
17. POWER PANEL
18. LIGHTING PANEL

AREA III

1. ACQUISITION AID CONSOLE
2. SERVO
3. DISPLAY RECORDER
4. FLIGHT CONTROLLER CONSOLE:
   CAPSULE COMMUNICATOR
   AEROMEDICAL MONITOR
   CAPSULE MONITOR
5. M & O SUPERVISOR DESK
6. COMMUNICATIONS TECHNICIAN CONSOLE

FIGURE 10-12. FLOOR PLAN, TELEMETRY AND CONTROL AREA — CANTON ISLAND

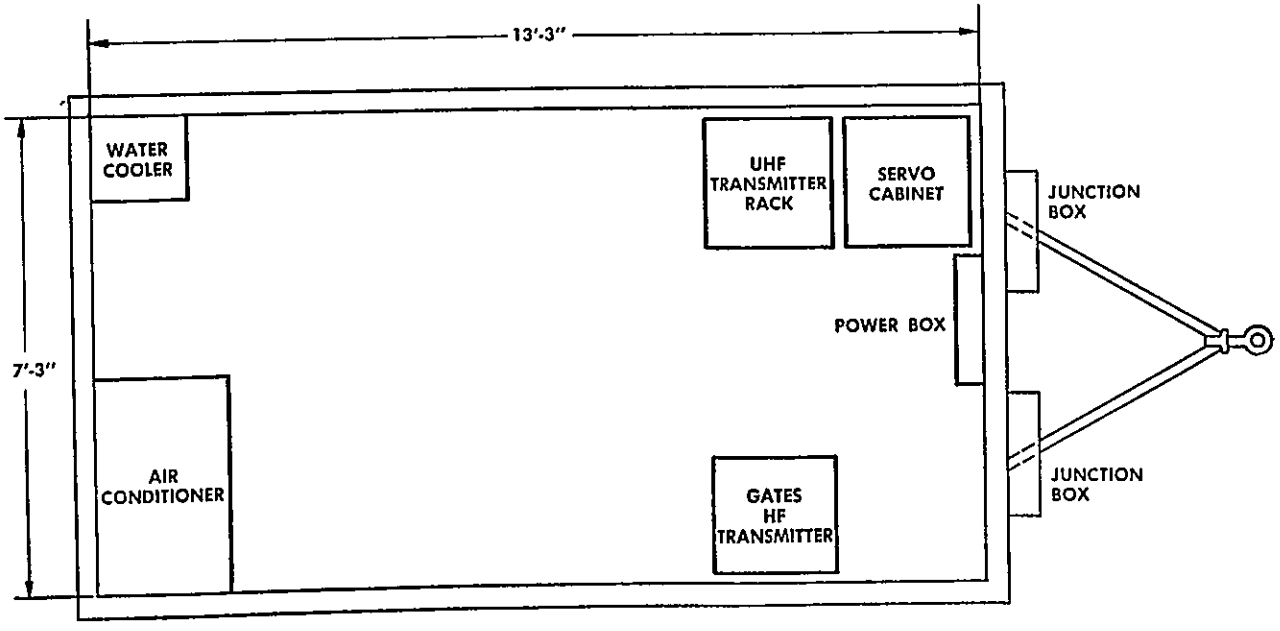


FIGURE 10-13. FLOOR PLAN, TRANSMITTER VAN

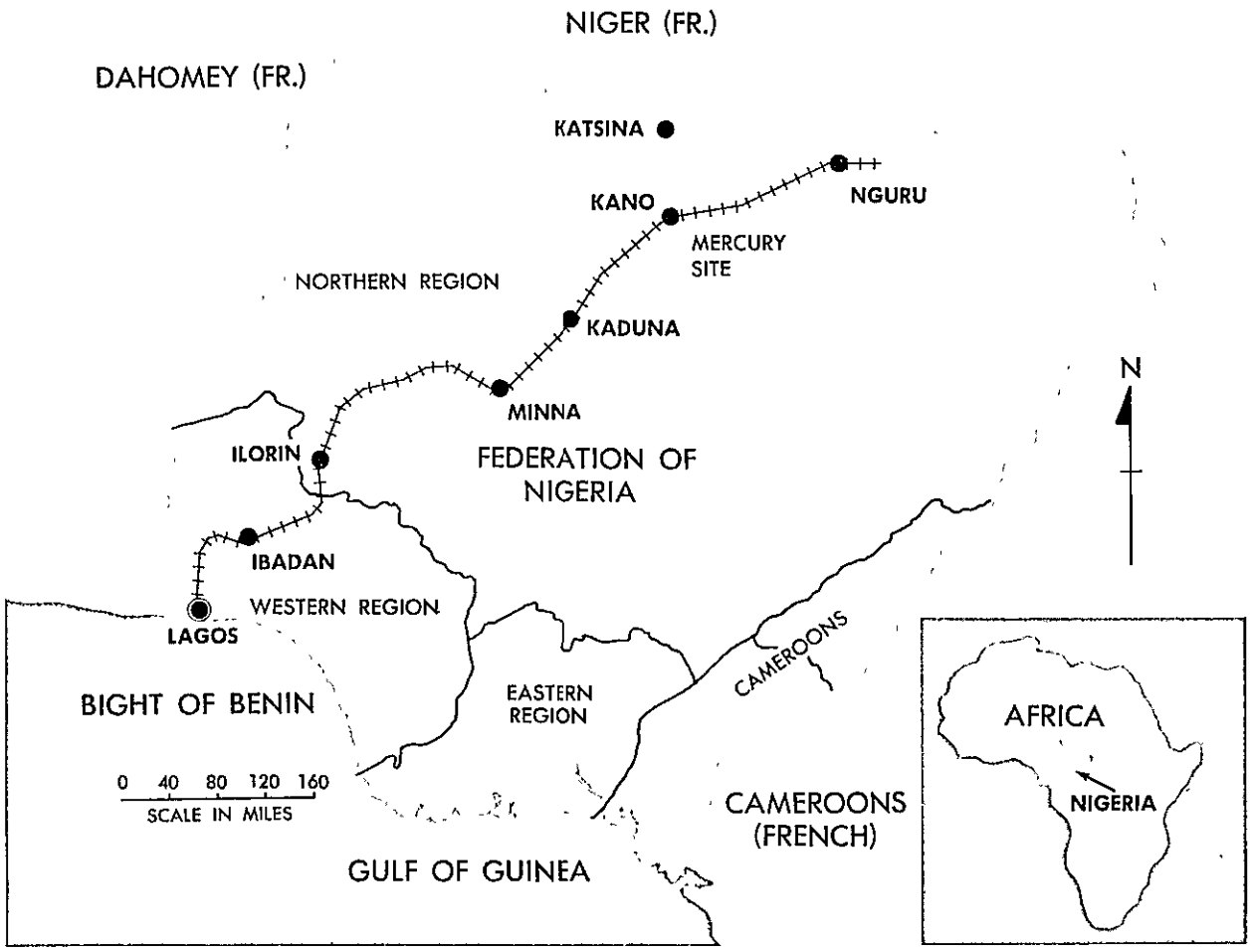


FIGURE 10-14. SITE LOCATION — KANO, NIGERIA

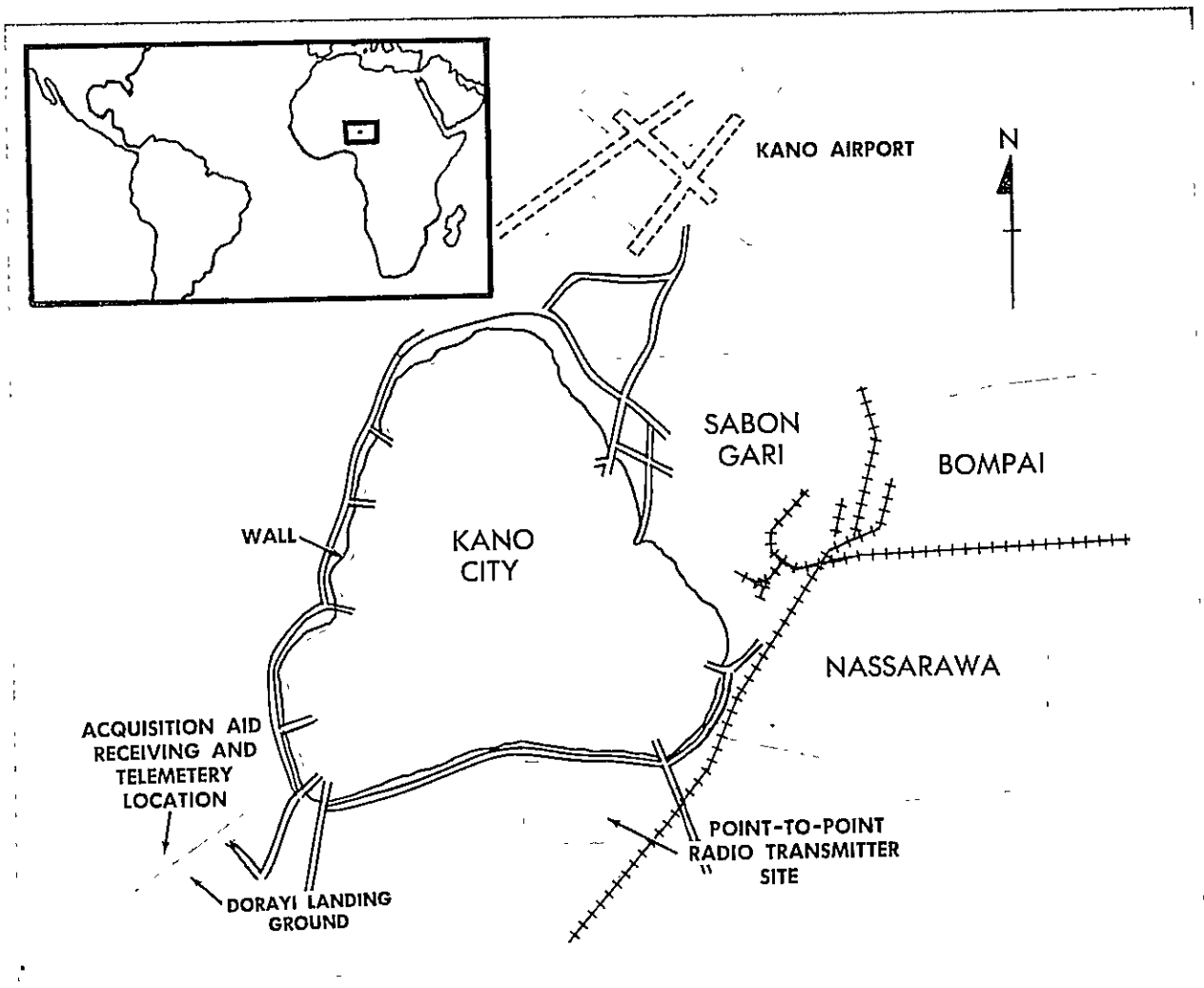


FIGURE 10-15. AREA LOCATION — KANO, NIGERIA

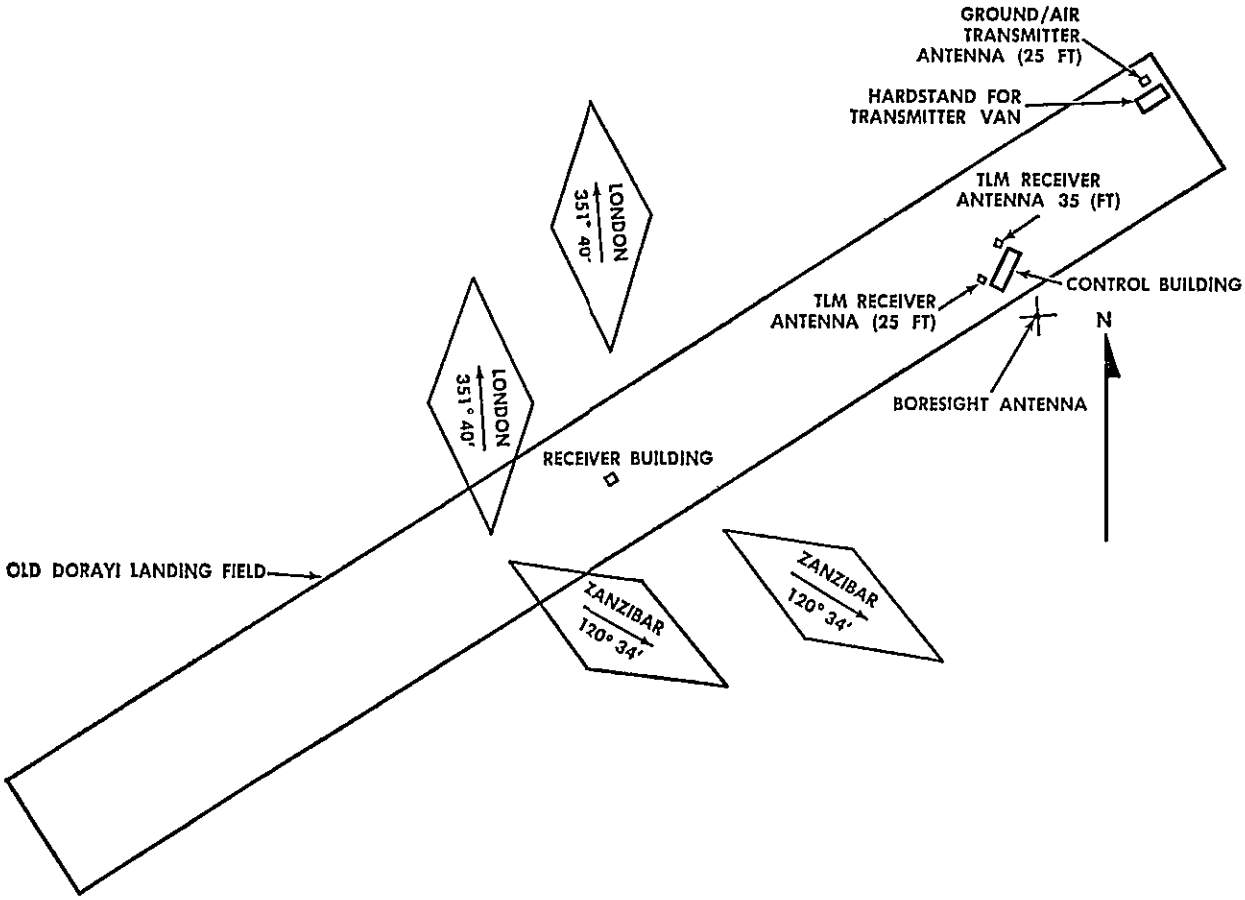


FIGURE 10-16. RECEIVER INSTALLATION—KANO, NIGERIA

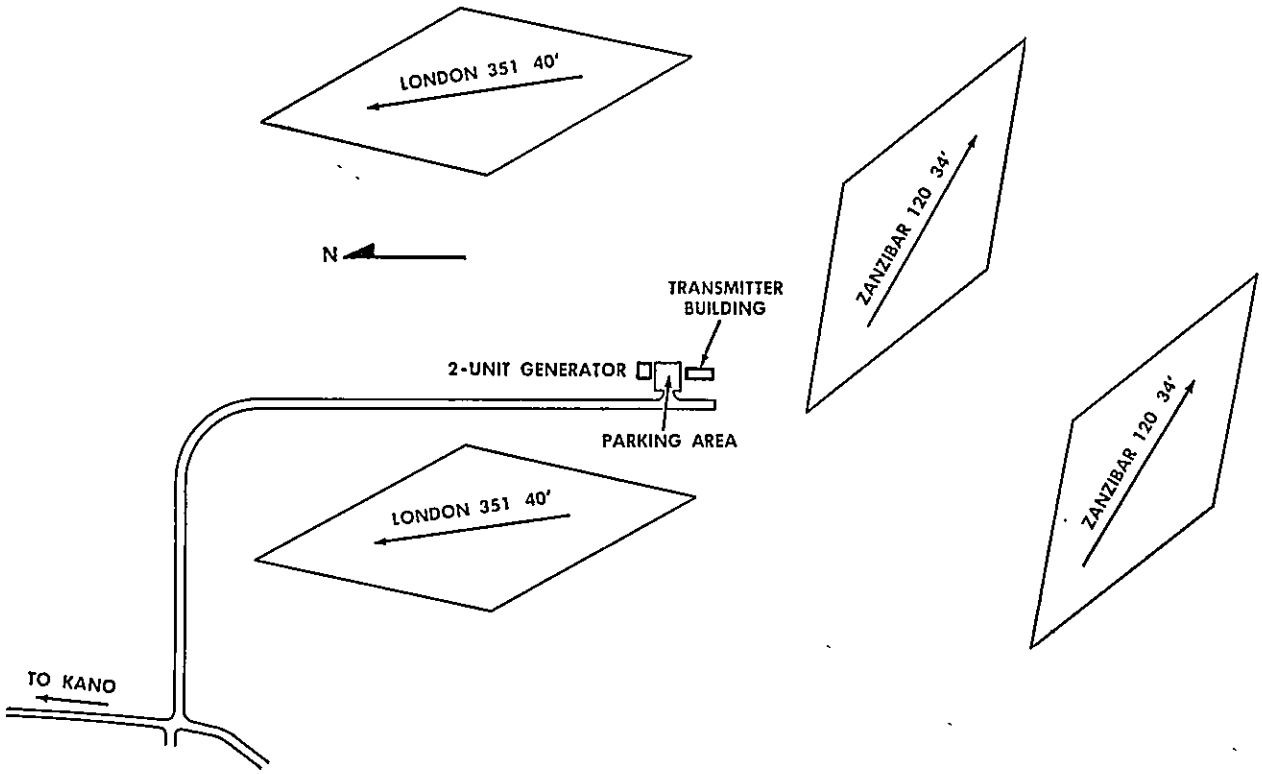
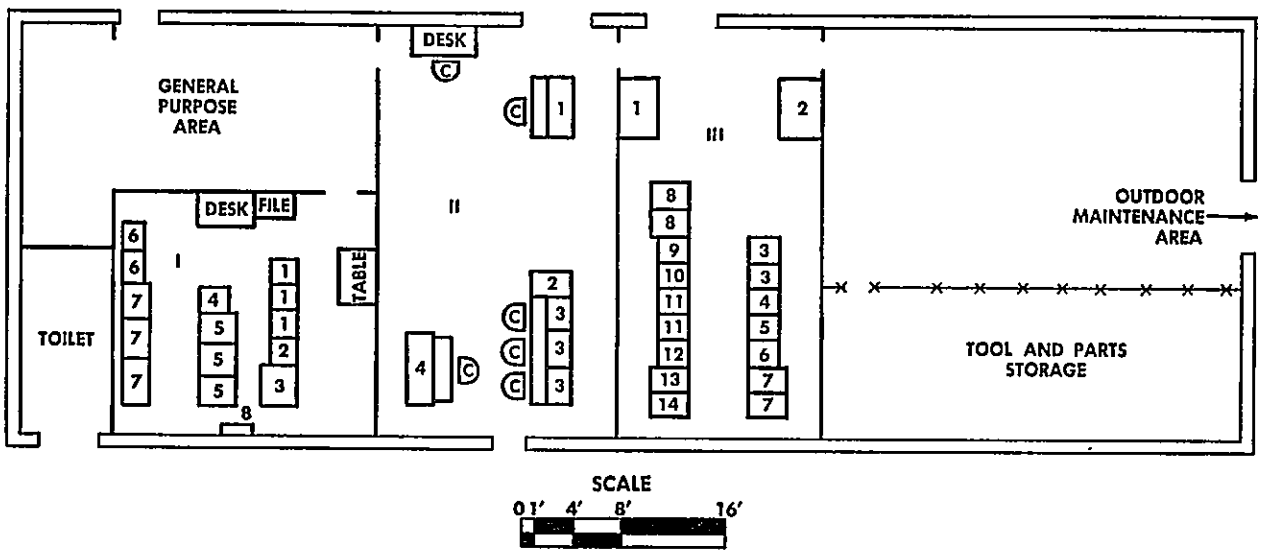


FIGURE 10-17. TRANSMITTER AREA — KANO, NIGERIA



AREA I

1. RELAY RACK
2. MISCELLANEOUS POWER
3. 105D POWER PLANT
4. SEQUENTIAL SELECTOR
5. 28RT
6. 28RO
7. 28ASR
8. POWER DISTRIBUTION PANEL

AREA II

1. ACQUISITION DATA CONSOLE
2. DISPLAY RECORDER
3. FLIGHT CONTROLLER CONSOLE: CAPSULE COMMUNICATOR, AEROMEDICAL MONITOR, CAPSULE MONITOR
4. COMMUNICATIONS TECHNICIAN CONSOLE

AREA III

1. STORAGE CABINET
2. WORK BENCH
3. TIMING STANDARD
4. DECOM MONITOR
5. 90/90 DECOM
6. EVENTS RECORDER
7. PEN RECORDERS
8. VOICE RECEIVERS
9. DISCRIMINATOR
10. CALIBRATOR
11. RECEIVERS
12. CONT
13. REPRO
14. TAPE RECORDER

FIGURE 10-18. FLOOR PLAN, TELEMETRY AND CONTROL AREA — KANO, NIGERIA; ZANZIBAR

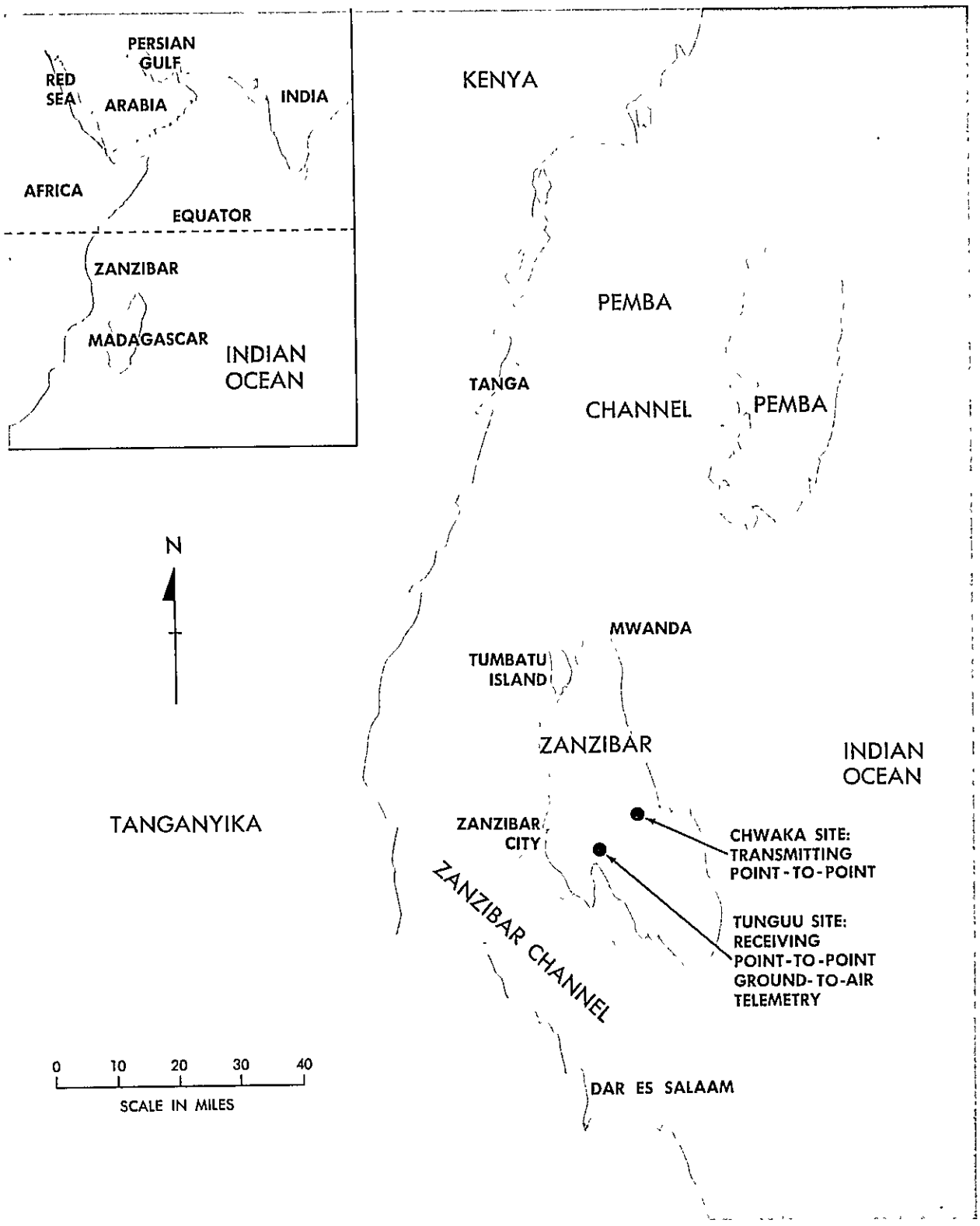


FIGURE 10-19. SITE LOCATION — ZANZIBAR

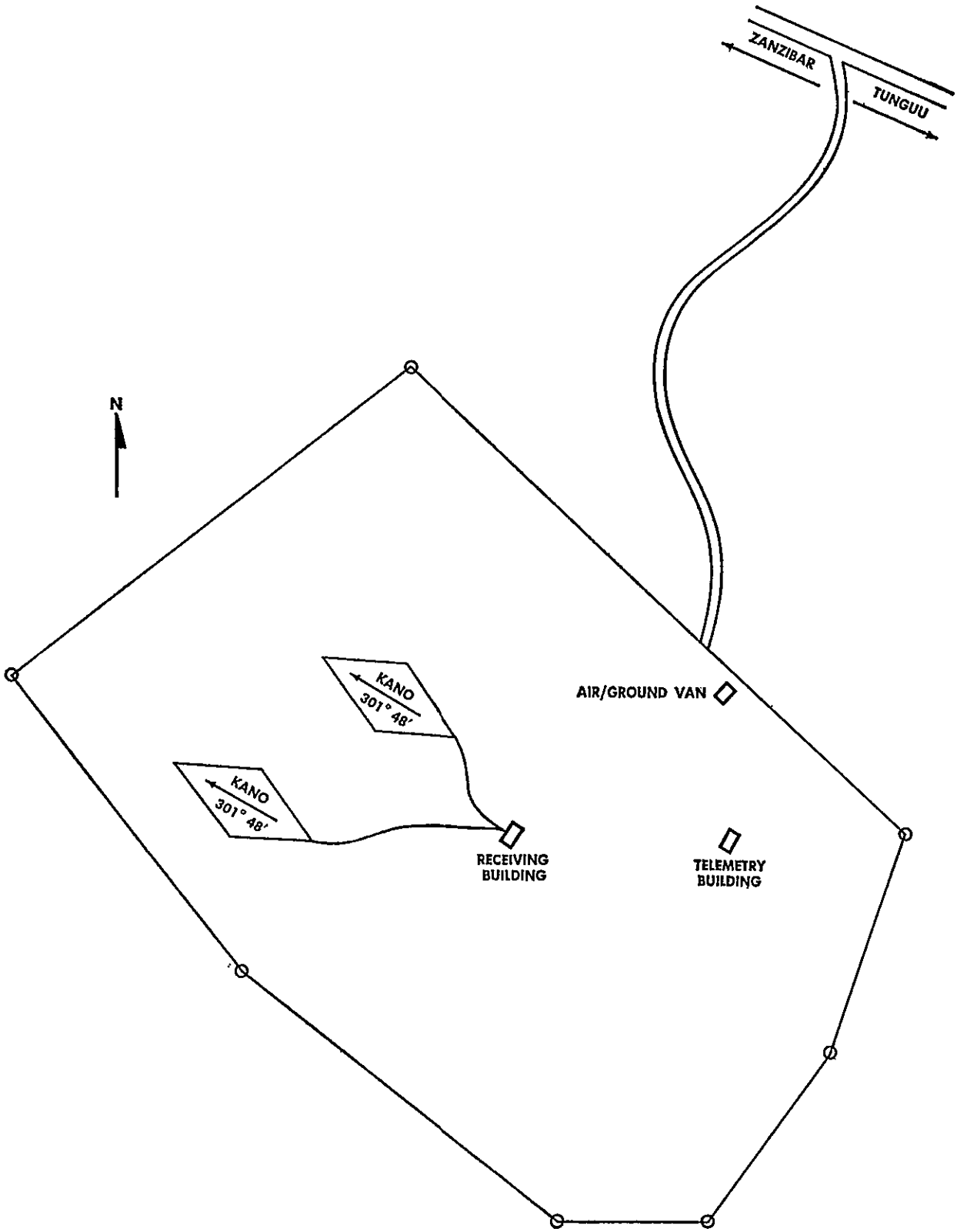


FIGURE 10-20. TUNGUU RECEIVER SITE — ZANZIBAR

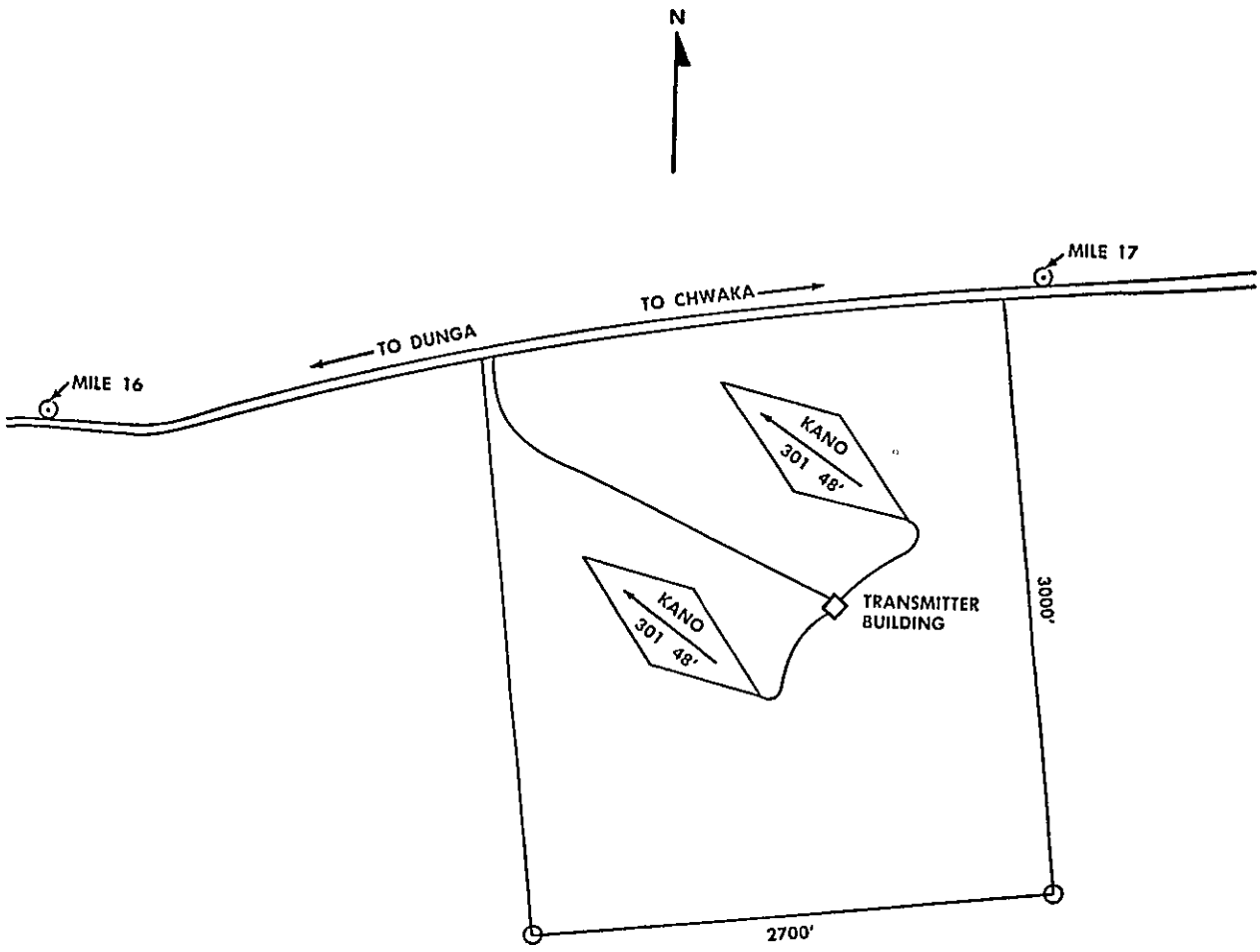
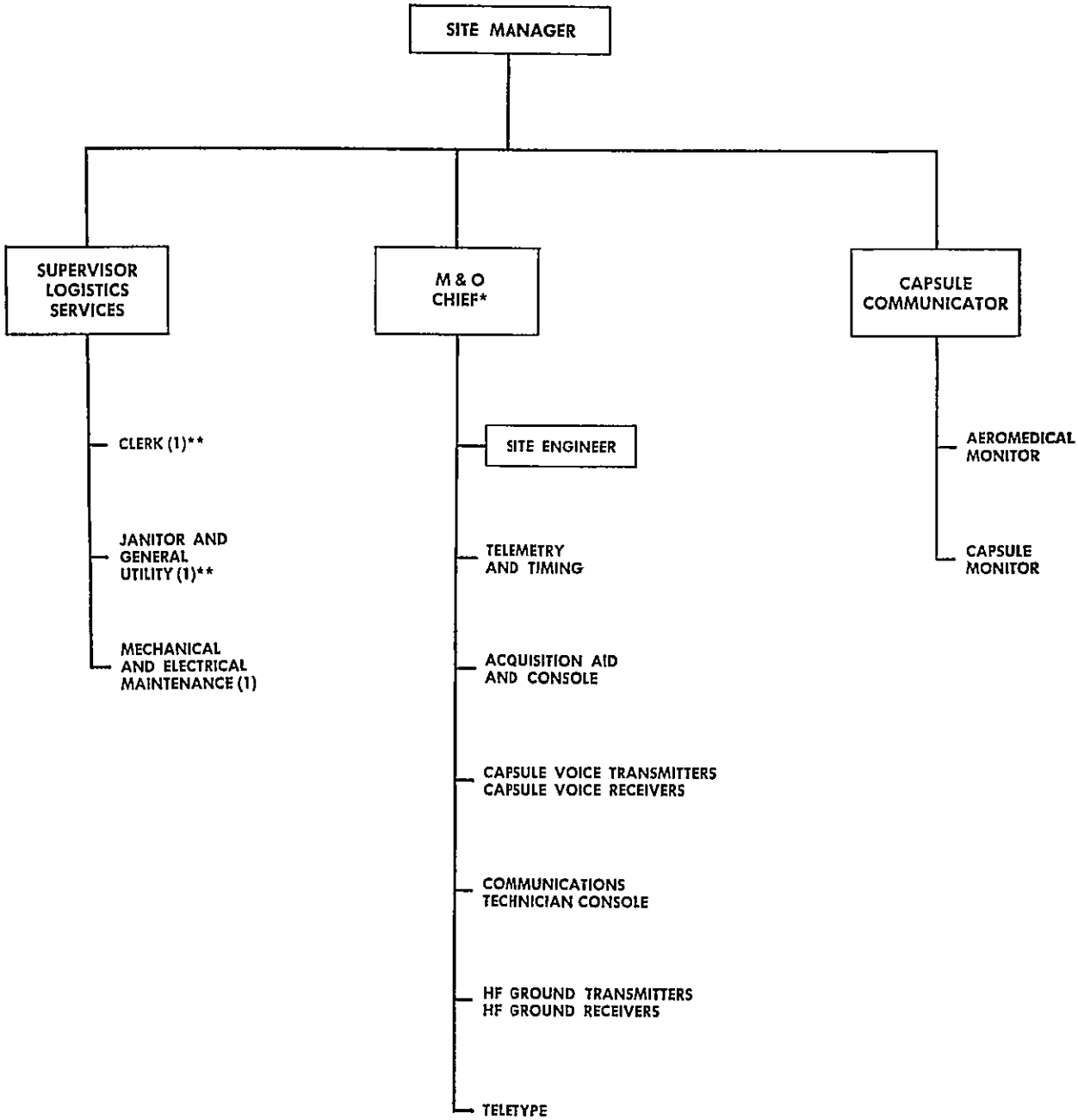
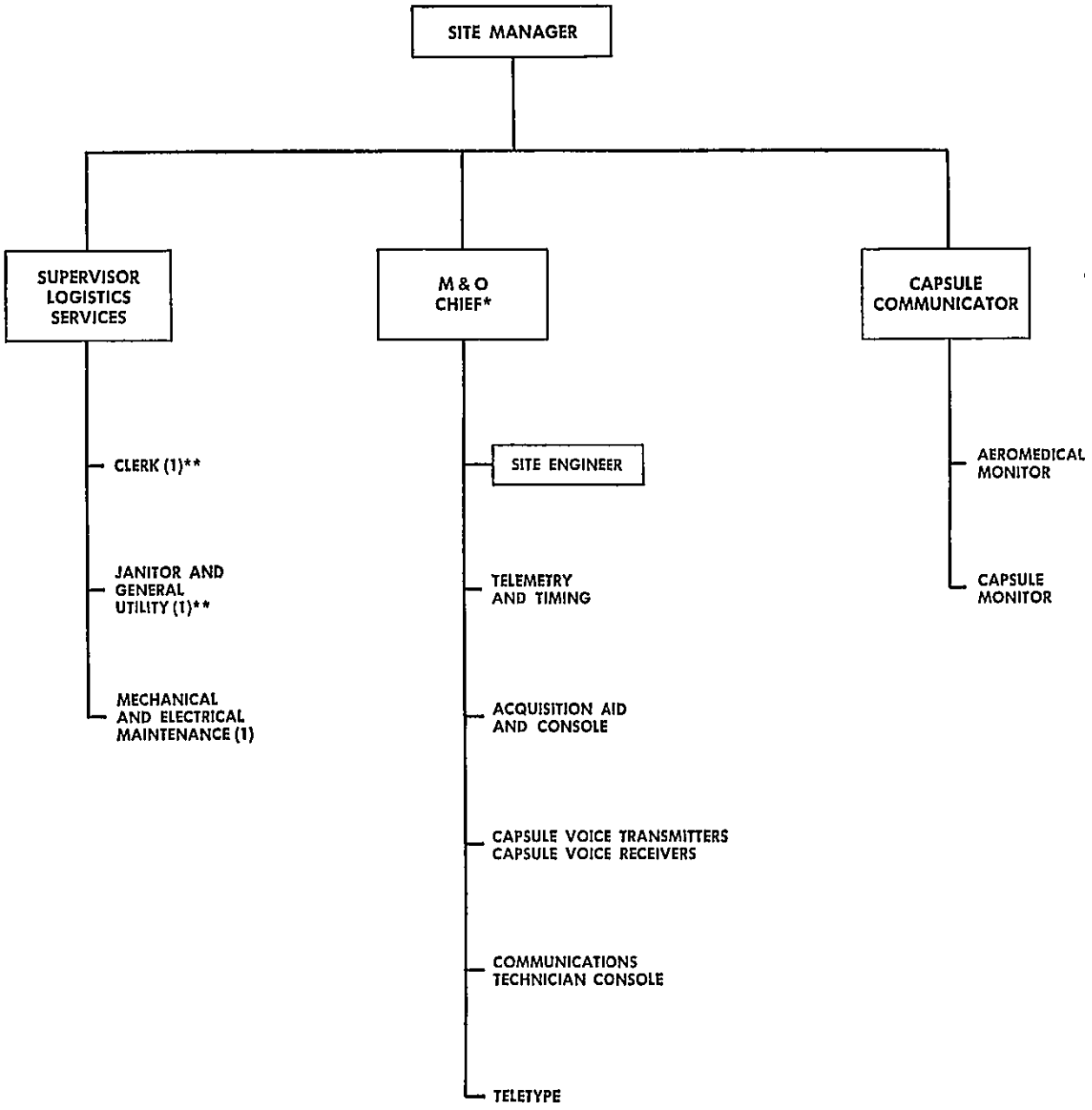


FIGURE 10-21. CHWAKA TRANSMITTER SITE — ZANZIBAR



*OPERATES TECHNICIANS INTERCOM POSITION
**DURING FLIGHT OR DRILL, ASSISTS IN MESSENGER SERVICE AND MONITORS RECEIVE-ONLY TELETYPE EQUIPMENT

FIGURE 10-22. SITE ADMINISTRATION — KANO, NIGERIA; ZANZIBAR



*OPERATES TECHNICIANS INTERCOM POSITION
**DURING FLIGHT OR DRILL, ASSISTS IN MESSENGER SERVICE AND MONITORS RECEIVE-ONLY TELETYPE EQUIPMENT

FIGURE 10-23. SITE ADMINISTRATION — CANTON ISLAND

ABBREVIATIONS

These abbreviations are defined elsewhere in the manual but are listed here for ready reference.

AM	Amplitude Modulation
AR	Acquisition and Receive
ATS	Atlantic Ship
BDA	Bermuda
BOAC	British Overseas Airways Corporation
C	Command
CADDAC	Central Analogue Data Distributing System
CAL	Point Arguello, California
CNV	Cape Canaveral
CTN	Canton Island
CW	Continuous Wave
CYI	Grand Canary Island
DECOM	Decommutation
EGL	Eglin, Florida
FM	Frequency Modulation
GBI	Grand Bahama Island
GMT	Greenwich Mean Time
GTI	Grand Turk Island
GYM	Guaymas, Mexico
HAW	Kauai Island, Hawaii
HF	High Frequency
ICW	Interrupted Continuous-Wave
IOS	Indian Ocean Ship
IRIG	Interrange Instrumentation Group
KNO	Kano, Nigeria
KLM	Royal Dutch Airlines
KW	Kilowatt
LSM	Landing Ship — Miscellaneous
M&O	Maintenance and Operating
MC	Megacycle
MCC	Mercury Control Center
MUC	Muchea, Australia
NASA	National Aeronautics and Space Administration
PAA	Pan American Airways
PAM	Pulse Amplitude Modulation
PBX	Private Branch Exchange (Telephone Switchboard)
R	Receive
SSB	Single Side Band
T	Transmit
T&C	Transmitting and Command
TEX	Corpus Christi, Texas
TLM	Telemetry
UHF	Ultra High Frequency
VFR	Visual Flight Requirements
WHS	White Sands, New Mexico
WOM	Woomera, Australia
WWV	Call letters for Bureau of Standards radio station
ZZB	Zanzibar Island