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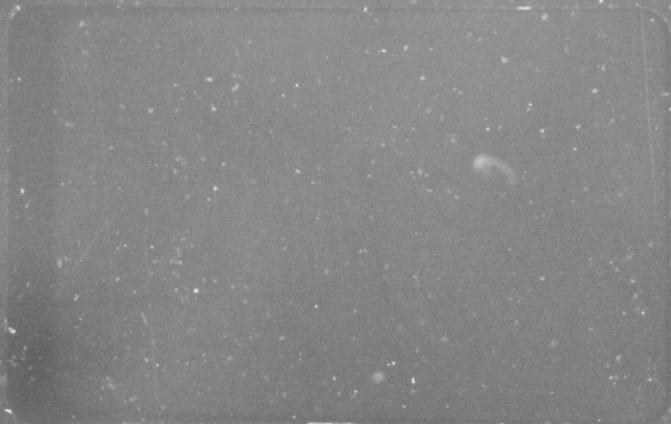
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CONVAIR DIVISION OF GENERAL DYNAMICS CORPORATION

AD833346

MARK II AZUSA TRACKING EQUIPMENT

AIRCRAFT TRACKING TESTS

PROGRAM PLAN

OCT 22 1959

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Ground Trajectory Measurement & Control

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REVISIONS

NO.	DATE	BY	CHANGE	PAGES AFFECTED

FOREWORD

The schedules indicated in this test plan are based upon satisfactory completion of tests preceding aircraft tracking tests in accordance with the Mark II Azusa Tracking Equipment Master Test Schedule dated 22 September 1958.

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Mark II Azusa Tracking EquipmentAircraft Tracking Tests1.0 Introduction

→ The Mark II Azusa Tracking Equipment test program being conducted at Convair-Astronautics, San Diego, California, in accordance with the requirements of Contract AF 08(606)-1013 includes testing the system during the time it tracks a slow-speed aircraft equipped with an Azusa transponder. These tests will be conducted after satisfactory subsystem performance has been verified during the required electronic and environmental tests.

2.0 Purpose

→ The primary objectives of the aircraft tracking tests are to determine:

- (a) Tracking capability of the system under dynamic conditions.
- (b) Capability of the system to automatically resolve ambiguities in range and direction cosines.

A secondary objective is to develop standard maintenance, calibration and operational procedures for use after system installation at the AFMTC. () ←

3.0 Test Program

The tests to be conducted are identified as follows:

- (a) Qualitative Aircraft Tracking Test.
- (b) Preliminary Ambiguity Resolution Test.
- (c) Ambiguity Resolution Test.

The approved test procedures for conducting these tests are described in detail in Convair Report No. AZN-26-027, dated 23 April 1958. The test schedule is indicated in Figure 1.

AIRCRAFT TRACKING TESTS

1959

JAN			FEB			MARCH			APRIL			MAY			JUNE									
9	16	23	30	6	13	20	27	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26

Qualitative

1 1 1 1 1 1 1 1 1 1 1

Preliminary
Ambiguity
Resolution

2 2 2 2 2

Ambiguity
Resolution

2 2 3 3

NOTE: Numbers indicate number of days by week that
aircraft tracking tests are planned.

FIGURE 1

4.0 Support and Services

The successful completion of the test program on schedule is dependent upon support and services, identified below, being provided when required:

- a. Slow-speed aircraft.
- b. Voice Communication Equipment.
- c. Azusa Type "B" Coherent transponder assemblies, (2), or equivalent.
- d. Test tower transponder installations.
- e. FCC licenses.
- f. Antenna position surveys.
- g. Test Equipment.
- h. Data Reduction, Analysis and Evaluation.
- i. Final Engineering Report.

B-1 would be better but hard to get. Otherwise require an inverter dc to ac. $\pm 2\%$.

These items are required at the times, and for time durations, indicated in Figure 2.

4.1 Aircraft

The aircraft to be used for the tracking tests must be capable of continuous airborne operation for a period of four (4) hours, and flying to a range of 50 miles from the Azusa site while maintaining an altitude of approximately 15,000 feet. Preferably, it will have adequate 115 volt, 400 cycle, power for operating the Azusa transponder, and will be pressurized. The AFMTC has been requested to indicate its decision by 15 November 1958 as to whether Convair will be allocated a bailed aircraft or receive contractual authorization to rent aircraft for the required test period. Convair has

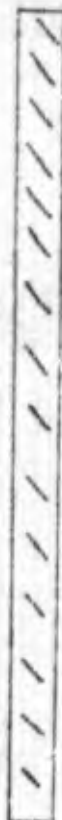
Assumes inverter in aircraft installation. NG. Ask for dc power inverter (regulated supply).

SUPPORT AND SERVICES REQUIREMENTS SCHEDULE

1959

JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY
-----	-----	-------	-------	-----	------	------

Aircraft



Communication Equipment



Transponders ~~Assemblies~~ [?]
Type "B" Coherent
Inverters



Test Towers



FCC Licenses



Antenna Position Surveys



Test Equipment



Data Reduction, Analysis
and Evaluation



Final Engineering Report



Report: AZN-26-056

Page: 4

FIGURE 2

indicated to the AFMTC that if the decision is to provide a bailed aircraft, authorization is requested to modify the aircraft as required to install an Azusa transponder assembly.

here this!
In the event a bailed aircraft is provided, it is assumed the aircraft will have voice communication equipment installed and

→ adequate 28 volt power to operate an inverter for powering the Azusa transponder. After the aircraft has arrived in San Diego and is

oh! → install a transponder assembly (transponder, inverter, associated cabling, antenna, cooling equipment, control and monitoring

No! Hours? When? Field Service → circuits) will be defined. Electronic design of the transponder assembly will be accomplished by 551-5. Assistance from 545-3 will be required to prepare bracket and installation drawings as required for installation of equipment. Installation of equipment will be accomplished by Dept. 756. Routine installation, checkout,

No! → and removal of the transponder assembly will be accomplished by Dept. 756 with the assistance of 551-5; transponder maintenance will be accomplished by Dept. 321. Arrangements for special test equipment and primary power required for ground checkout of the equipment will be the responsibility of 551-3.

In the event the AFMTC authorizes Convair to rent aircraft, a purchase order shall be sent out for bid by 15 December 1958. The purchase order shall include provisions for:

- a. Modification of the aircraft to accept a transponder assembly and 28 volt batteries if required.

- b. Access to the aircraft by Convair personnel to determine modifications required, perform modifications, install equipment, checkout the equipment as required, and remove equipment.
- c. Rental of aircraft with pilot for 120 hours' flight time during the period of the test program.
- d. Scheduling the use of the aircraft for tests on 12 hours' notice beginning 1 March 1959.
- e. Assuring that the aircraft is equipped with approved communication equipment, operable on frequencies assigned to Convair.

The required work is the same as for the bailed aircraft.

The detailed schedule for the aircraft is shown in Figure 3.

The pilot(s) assigned to operate the aircraft -- bailed or leased -- will be given an indoctrination in the requirements of the test program, as relates to the aircraft, starting approximately 1 February 1959. The extent of indoctrination will be dictated by whether or not the pilot(s) has a security clearance. If a bailed aircraft is used, the pilot will be one of the following and have a security clearance:

- a. An Air Force officer from the AFMTC.
- b. An Air Force officer from the AFPR office.
- c. A Convair, San Diego Division, Flight Department, employee.

The pilot of a rental aircraft will not (most likely) have a security clearance. It is believed that this indoctrination will develop an appreciation, by the pilot(s), of the complexity and intent of our test program that will be highly beneficial during actual tracking operations.

AIRCRAFT SCHEDULE

1958		1959				
NOV	DEC	JAN	FEB	MAR	APR	MAY JUNE

AFMTC Decision - - Bailed or
Rental

BAILED AIRCRAFT

Available in San Diego

Transponder Assembly Installation

Airborne Checkout

RENTAL AIRCRAFT

Requirements to Purchasing

Purchase Order Out for Bids

Purchase Orders Awarded

Define Aircraft Modification

Transponder Assembly Installation

Airborne Checkout

Tracking Tests

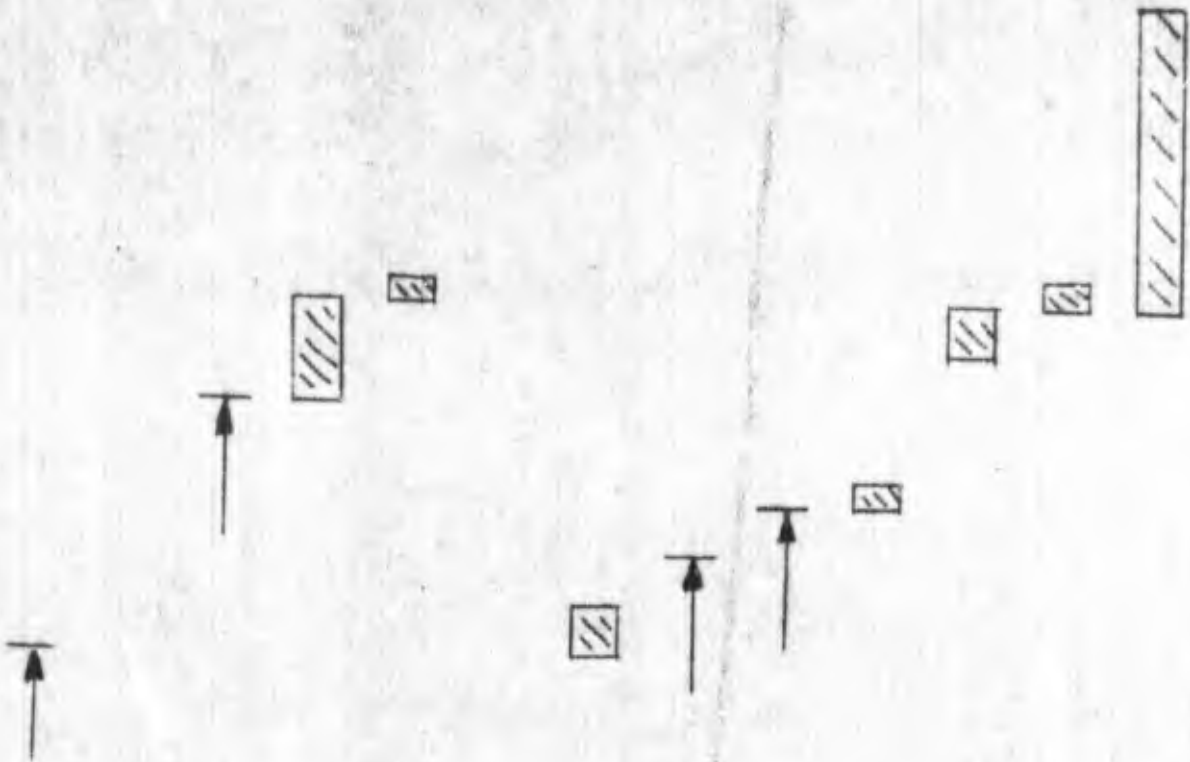


FIGURE 3

4.2 Communications

Three sets of voice communication equipment are required to support the test program. Each set shall consist of a transmitter-receiver with power supply, antenna and microphone suitable for mobile use. One set will be used at the Mark II Azusa ground station for communications with the aircraft, the second set will be used at the Mark II Azusa ground station for communications with the remote transponder test tower, and the third set will be used at the remote transponder test tower to communicate with the Mark II Azusa ground station.

Convair-Astronautics has requested the AFMTC to indicate by 15 November 1958 whether the AFMTC will provide communication equipment for ground-to-air communications as GFE or authorize Convair-Astronautics to purchase suitable equipment. This equipment shall have a line-of-sight operating range of at least 75 miles, be suitable for mobile operation, and operate on frequencies of 123.1, 123.3, 123.4 and 123.5 megacycles.

The two sets of communication equipment used for ground-to-ground communications (walkie-talkies) shall be obtained on a loan basis from Convair-Astronautics Industrial Security (Dept. 130-1).

The ground-to-air transmitter-receiver with power supply and microphone shall be installed in or near the control console in Building 23 by Dept. 756 personnel in accordance with instructions from 551-3 System Integration. The antenna shall be installed by Dept. 250 (Plant Engineering) in accordance with requirements from 551-3

System Integration; an assist order, authorizing Dept. 250 to provide this assistance, will be required.

The other two sets of communication equipment (walkie-talkies) shall be stored in Building 23, after initial performance checks, until required for use.

In the event an antenna is not provided as a part of the ground-to-air communication equipment, assistance will be required from 551-7 to design and fabricate one antenna. G. C. Tweed, Jr., has indicated that a quarter-wave stub over a counterpoise will be adequate for our requirements and that an antenna can be fabricated in approximately five (5) hours.

Performance checks of the communication equipment and day-to-day operation during tracking tests shall be accomplished by 551-3 personnel.

The detailed schedule for the ground-to-air communication equipment is shown in Figure 4.

4.3 Transponders

Two (2) Azusa Type "B" coherent transponders with inverters, or equivalent, are required to support the test program. One unit will be installed in the aircraft employed for the tracking tests, and the second unit will be used at the remote transponder tower; one of the units may be used occasionally with the Mark II Azusa reference waveguide system.

1958		1959					
NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE

AFMTC Decision - - GFE or
Convair-purchased

GFE

Available in San Diego

Installation & Checkout, Bldg. 23

PURCHASED

Requirements to Purchasing

Purchase Order out for Bids

Purchase Order Awarded

Equipment Delivery

Installation & Checkout, Bldg. 23

Tracking Tests

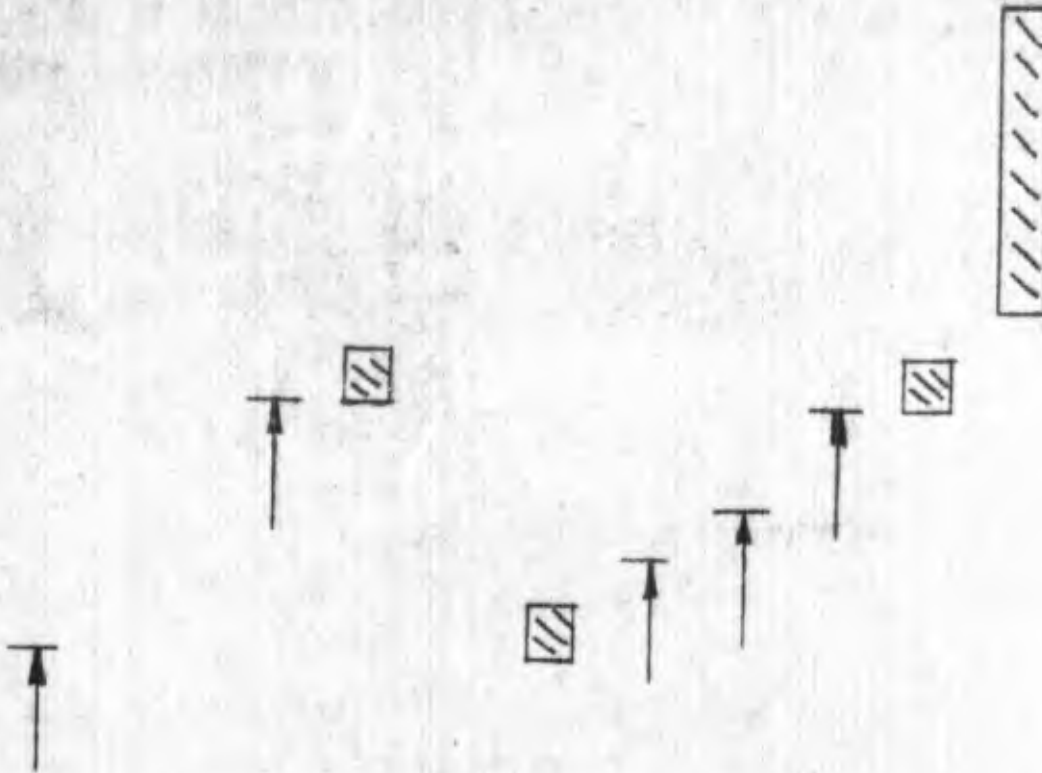


FIGURE 4

The transponders and inverters will be provided to Convair-Astronautics as GFE by the AFMTC. The transponder antenna for aircraft installation is presently available in 551-3 (G. Moses). Assistance required for installation, maintenance, and test of the transponder assembly to support the schedule indicated in Figure 3 is described in paragraph 4.1.

4.4 Transponder Test Towers

Two (2) transponder test towers, or equivalent, will be provided for static testing of the Mark II Azusa Tracking Equipment. A fixed installation will be located at the top of the water tower adjacent to Building 23, and a portable installation will be fabricated for use at remote locations.

4.4.1 Water Tower Installation

The water tower installation will consist of a horn antenna with filter located near the top of the water tower. A Helix cable, or equivalent, will transmit [] signals from the MO-LO cabinet in Building 23 to the horn antenna. Work on this installation was completed by 551-7 and Dept. 756 personnel on 14 November 1958.

4.4.2 Portable Transponder Tower

An Azusa Type "B" Coherent transponder assembly (transponder, inverter, antenna, battery power supply, cooling equipment, and cabling) will be employed for the portable transponder tower. The transponder assembly will be installed on a platform, suitable for portable use, by Dept. 756 personnel.

The transponder assembly will be placed on a four-wheel drive vehicle provided by Dept. 214-2 (Transportation) and moved to the location specified for the test by the Test Coordinator. After completion of a test, the transponder assembly shall be returned to Building 23 for maintenance and storage. Handling and maintenance of the transponder assembly shall be accomplished by Dept. 756 and 321, respectively. Operation of the transponder assembly shall be controlled by the Test Coordinator.

Authorization has been requested and received to locate a transponder assembly on Fortuna Peak during the period of the test program. Fortuna Peak is located on U.S. Navy property (Camp Elliott) approximately $4\frac{1}{2}$ miles East-Northeast of the Mark II Azusa test facility. A sales order setting forth the conditions of access and use of this area has been issued by Contracts Department (S.O. 1011-1-42 dated 13 October 1958).

A fixed installation on Fortuna Peak is not planned at the present time; however, we may temporarily locate a transponder assembly in this area during the period of a Mark II Azusa aircraft tracking test.

The transponder test towers will be required for Mark II Azusa tracking equipment testing associated with the aircraft tracking tests for the period from 15 January 1959 to 1 June 1959.

4.5 FCC Licenses

Regulations of the Federal Communications Commission require that we obtain FCC licenses authorizing radiation of R.F. energy from the Mark II Azusa Tracking Equipment, the Azusa transponders, and voice communication equipment used for two-way communications. Two of the four licenses required have been obtained. Pertinent details of these licenses are as follows:

Mark II Azusa Tracking Equipment

Call Sign: KM2XKI

File Number: 532-ER-P/L-59

Nature of Service: Experimental (Research)

Class of Station: Contract Developmental

Frequency: 5000 - 5250 mc

Emission Designator: 10CF9

Authorized Power: 2300 watts

Special Provisions: None

Tolerance: .05%

Hours of Operation: Unlimited

Communications: In accordance with Section 5.202(c) of the Commission's Rules

Authorization Effective: 23 September 1958

Authorization Expires: 1 February 1960

Azusa Transponders

Call Sign: KM2XHU

File Number: 340-ER-R-58

Nature of Service: Experimental (Research)

Class of Station: Contract Developmental

Frequency: 5000 - 5060 mc

Emission Designator: 40F0

Authorized Power: 10 watts

Special Provisions: None

Tolerance: .05%

Hours of Operation: Unlimited

Communications: In accordance with Section 5.202(c) of the Commissions Rules

Authorization Effective: 1 February 1958

Authorization Expires: 1 February 1959*

*NOTE: This license will be renewed automatically.

Convair currently holds an FCC license, call sign KMV7, authorizing transmissions on voice communication frequencies of 123.1, 123.3, 123.4, and 123.5 mc subject to certain restrictions. This license is effective until June 1962, specifically authorizes mobile operations, and specifies communication equipment used by Convair, San Diego Division (Electronics Section and Flight Department). In the event the communication equipment allocated or selected for use during our test program is different than equipment specified on this license, it will be necessary to request that the license

be modified to include our equipment.

Of the frequencies specified above, Convair has control of 123.4 mc only. The frequency of 123.1 mc is for emergency (distress) use only, and 123.3 and 123.5 mc frequencies are controlled by other aircraft companies in the Southern California area (Lockheed and Douglas). The frequencies of 123.3 and 123.5 mc may be used provided the controlling licensee (Lockheed or Douglas) is contacted and agrees to such use for a specific day and period of time.

The use of 123.4 mc within Convair is controlled by Mr. W. B. Harwell, San Diego Division, Flight Department. Mr. Harwell's approval is required prior to use of this frequency.

Operations under these licenses are subject to CONELRAD (Control of electronic radiation) alerting requirements. The CONELRAD alerting requirements applicable to our operations are:

- a. We will receive the CONELRAD radio alert by monitoring KSDO, San Diego and/or KFI, Los Angeles during the time any Azusa transmitting equipment (Mark II Azusa transmitter, Azusa transponders, and 2-way voice communication equipment) is in operation.
- b. We will comply with the CONELRAD radio alert:
 - (1) During an actual alert, by discontinuing all radio transmissions (including the carrier) unless they are of an emergency nature affecting the national safety or the safety of people and property.

(2) During a CONELRAD radio alert test drill, by continuing normal operations.

c. We may resume normal operations upon receipt of the CONELRAD radio "all clear" after an actual alert.

d. We will record appropriate entries of all CONELRAD tests and operations monitored in operating logs.

The detailed CONELRAD regulations and information pertinent to our operations are included in Appendix A.

Operations under the FCC licenses shall be conducted in accordance with applicable FCC regulations. Convair-Astronautics DSP 1-17 places the responsibility for compliance with the applicable FCC regulations with the employee operating the transmitting equipment.

The FCC regulations include the requirements that an FCC licensed operator be responsible for operation of the voice communication equipment, station operation logs be maintained, and the use of voice communications be restricted to those requirements for which the license was issued.

4.6 Antenna Position Surveys

Performance of the Mark II Azusa tracking equipment is dependent upon the baseline antennas being positioned in the horizontal and vertical planes to within specified tolerances. All baseline antennas will be positioned accurately prior to and during the aircraft tracking test program to:

- (a) Develop routine positioning procedures.
- (b) Obtain a history of antenna position stabilities.
- (c) Enable resolution of data ambiguities.

The tentative schedule for positioning the baseline antennas is shown in Figure 2. The antennas will be positioned in accordance with the procedure titled "Azusa Mark II Tracking System Optical Check of Antenna Placements". This procedure is incorporated in the Mark II Azusa Antenna System Technical Note, AZN-26-035TN (to be published). Special tools required to position the antennas are listed in the above procedure.

It is planned to accomplish a preliminary positioning of the antennas in December 1958 after all antennas have been "sold" to the Air Force. Antenna positioning to within tolerances specified in the above procedure will be accomplished during January 1959, and antenna positions will be checked (and corrected as required) once a month thereafter for the duration of the test program. Fine adjustments of antenna positions will be made, during the last two months of the test program, as required to demonstrate ambiguity resolution capability of the Mark II Azusa Tracking Equipment.

All antenna position surveys will be performed by Dept. 756 personnel under the supervision of 551-3 personnel; special assistance and tools will be requested from Dept. 451 (Optical Tooling) as considered necessary by 551-3 personnel. This work will be accomplished at night with the antenna bubbles removed and the antenna storm covers installed in order to minimize effects on optical tools and Azusa antennas due to temperature variations and wind loading.

4.7 Test Equipment

Test equipment required for the aircraft tracking tests, additional

to the test equipment normally employed in day-to-day operation and maintenance of the Mark II Azusa tracking equipment, consists of the following:

1. Six (6) Esterline-Angus direct writing pen recorders Type AW, or equivalent.
2. One (1) tape recorder, Knight Model KN-4020, or equivalent.
3. Three (3) sets mobile 2-way voice communication equipment complete with power supplies and antennas.
4. Transponder checkout equipment (to be defined).
5. Auxiliary Power Unit, 28 volts (for ground checkout of transponders in aircraft).

The above items of test equipment will be acquired by 551-3 System Integration from the following sources:

<u>Item</u>	<u>Source</u>
1	Engineering Standards Lab
2	Engineering Facilities Planning
3	AFMTC or purchased
4	551-5
5	Engineering Facilities Planning

These items are required for the period from 15 February to 1 June 1959.

4.8 Data Reduction, Analysis and Evaluation

Data will be recorded during the aircraft tracking tests as specified in AZN-26-027. The raw data will consist of magnetic tape digital data, CEC analog data, Esterline-Angus analog data, magnetic tape

test continuity data, and operating log data.

4.8.1 Data Reduction Requirements

The data reduction requirements, by test, are as follows:

4.8.1.1 Qualitative Aircraft Tracking Test

No formal requirement; recording, reduction and analysis are to be accomplished at the discretion of the Test Coordinator.

(COMMENT: Magnetic tape digital recordings of "l", "m", r_m , r_{cc} and t and CEC recordings will be made to evaluate equipment and system performance.

Tabulation of "l", "m", r_m , r_{cc} , t , and first and second differences for selected time intervals and spot-checking of CEC-recorded functions at selected time intervals will be required.)

4.8.1.2 Preliminary Ambiguity Resolution Test

Plot range and cosine discriminator errors versus azimuth at ten (10) degree intervals, and range discriminator errors versus range at ten (10) mile intervals, from the Esterline-Angus recordings. A minimum of three (3) circle runs, five (5) chord runs, and one (1) range run will be recorded and the data plotted.

(COMMENT: Same as comment under 4.8.1.1)

4.8.1.3 Ambiguity Resolution Test

Same as 4.8.1.2 except that discriminator errors will also be recorded with the CEC recorder to show intermediate agreement with fine data and coarse agreement with intermediate data.

4.8.2 Data Reduction Methods

4.8.2.1 Esterline-Angus Records

This data will be manually extracted and plotted to appropriate scales from the direct-writing pen records by 551-3 personnel.

4.8.2.2 CEC Records

The CEC photographic paper records shall be developed by Dept. 120-5 (Still Photography Lab). The data required will be manually extracted and plotted to appropriate scales by 551-1 personnel.

4.8.2.3 Magnetic Tape Digital Data

Three (3) methods of extracting data from magnetic tape will be considered. The first method involves playback of the magnetic tape data into the Flexo-writer, the second method involves playback of the magnetic tape data into an IBM 704 computer, and the third method involves sending the Digital Data Handling System magnetic tape record to the AFMTC for reduction on the FLAC computer. Strictly interpreted, the data reduction requirements specified in

AZN-26-027 for the aircraft tracking tests do not require reduction of magnetic tape digital data. However, it is highly desirable from a standpoint of evaluating system performance (data noise, ambiguity resolution, system stability and equipment performance) to be able to rapidly convert digital data to tabulations and analog plots of "l", "m", r_m , r_{cc} and first and second differences versus time.

4.8.2.3.1 Flexowriter

The Flexowriter is a part of the Mark II Azusa Tracking Equipment. The magnetic tape digital data is played back through the Digital Data Handling System into the Flexowriter and the Flexowriter prints out the data in binary numbers on paper or paper tape. It is then necessary to manually convert from binary to decimal in order to process the data with available computer equipment or conduct a "spot" analysis of the data. Tabulations of data are obtained by either manually tabulating the data, or creating IBM cards for processing the data through a computer.

This method of data reduction will be

employed for conducting "spot" checks of equipment and system performance only.

4.8.2.3.2 IBM 704 Computer

This method of data reduction involves re-locating the Digital Data Handling System cabinet from Building 23 to the IBM 704 computer area in Building 4, providing interconnecting cabling and communication lines between the DDHS cabinet and the Mark II Azusa tracking equipment, providing interconnecting cabling between the DDHS cabinet and the IBM 704 computer, providing and installing signal restoring and impedance matching equipment, and playback of the data recorded on magnetic tape directly into the IBM 704 computer. This method of data reduction will be employed for reducing magnetic tape digital data acquired during the tracking test program.

The schedule and assistance required incidental to relocating the DDHS cabinet to Building 4 is indicated in Figure 5.

DIGITAL DATA HANDLING SYSTEM CABINET RELOCATION

1958 1959

NOV	DEC	JAN	FEB	MAR	APRIL	MAY
-----	-----	-----	-----	-----	-------	-----

Install Cabling, Bldg. 23
to Bldg. 4 (Dept. 250)



Terminate Cabling

(Dept. 756 and 551-3)



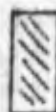
Move DDHS Cabinet to
Bldg. 4 (Dept. 756)



Connect Power to DDHS
Cabinet (Dept. 250)



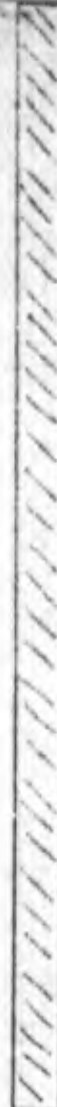
Provide Signal Restoring &
Impedance Matching Equipment
(Dept. 756 & 551-3)



Connect Cabling & Checkout
DDHS Cabinet (Dept. 756
& 551-3)



Operational Use



Reduction of data, using the IBM 704 computer, will be accomplished by 591-3 personnel with the assistance and as directed by 551-1 and 551-3 System Parameters personnel.

4.8.2.3.3 FLAC

In the event that the DDHS cabinet is not relocated to Building 4 as described under 4.8.2.3.2, the magnetic tapes containing digital data may be flown to the AFMTC, PAFB, Florida, and played back into the Florida Automatic Computer to obtain data tabulations; the tabulated data will be flown to Convair-Astronautics for additional reduction and processing by 551-1 and 551-3 personnel.

4.8.2.4 Operating Logs and Voice Recordings

Data contained in the operating logs and voice recordings will be used to define the status of operating conditions during the period of the test and to correlate equipment malfunctions that may occur with operating conditions during the test.

Extraction of applicable data from the operating logs and voice recordings will be accomplished by 551-3 System Parameters personnel.

4.8.3 Data Analysis and Evaluation

Analysis and evaluation of the data acquired during the test program shall be accomplished by 551-3 System Parameters personnel with the assistance, as required, of 551-1 personnel.

4.9 Final Engineering Report

The contractually required Final Engineering Report on the Mark II Azusa tracking equipment will include data acquired during the aircraft tracking test program, and conditions under which the data is acquired. 551-3 engineers will provide most of the data involved in rough form, and it will be necessary to have this data converted to the format and language required by the Final Engineering Report. It is required that an Engineering Writer from Dept. 322-5 with an Electronics Engineering (and preferably Azusa) background be assigned on a full-time basis to work with 551-3 personnel at Building 23 for the period from 19 January 1959 to 19 June 1959. The Engineering Writer assigned shall receive an indoctrination on the Mark II Azusa system and test program during the period from 19 to 30 January 1959, and gather and prepare material for the Final Engineering Report on a day-to-day basis thereafter.

The Engineering Writer shall be provided with a typewriter and desk space at Building 23 for the period of his temporary assignment.

5.0 Standard Operating Policies & Procedures

Standard operating policies and procedures for repetitive operations during the aircraft tracking test program are presented to establish an

operating routine. Deviations, because of special considerations and requirements, will be made at the discretion of the Test Coordinator.

5.1 Test Coordinator

The Test Coordinator shall be directly responsible for the coordination of all efforts required for the successful completion of the aircraft tracking tests. He shall:

- a. Coordinate and approve aircraft tracking test schedules.
- b. Notify and brief all personnel affected prior to a test.
- c. Determine that all required preparations are complete prior to starting a test.
- d. Direct all flight operations of the aircraft incidental to the test.
- e. Conduct the test in accordance with approved test procedures.
- f. Evaluate all malfunctions occurring during a test and direct appropriate action.
- g. Terminate a test when, in his opinion, such action is appropriate.
- h. Conduct a review of system operation during a test and direct appropriate action when required.
- i. Deliver all test data to 551-3 System Parameters for reduction, analysis, evaluation and recommendations.
- j. Maintain a log of all aircraft tracking test operations.

5.2 Mark II Azusa Tracking Equipment

Operating personnel shall verify satisfactory equipment, subsystem and system operation during the afternoon of the day prior to a scheduled aircraft tracking test. This shall include set-up and

calibration of all recording equipment to be used during the test.

Operational status reports shall be made verbally to the Test Coordinator prior to the end of working hours for the day.

Power to the Mark II Azusa Tracking Equipment shall be on for a minimum of two hours prior to the start of an aircraft tracking test. This period of time shall be utilized by operating personnel to monitor and verify satisfactory equipment, subsystem and system operation, analyze unsatisfactory operation and effect corrective action where required, check the calibration of recording equipment in terms of Azusa functions, maintain operating logs, and keep the Test Coordinator advised of operational status.

Operating personnel in charge of Systems shall maintain logs that document the operating history of each system. The log record covering preparations for a test and operations during a test shall be prepared in duplicate to permit delivery of one copy of the log to 551-3 System Parameters after the test.

Operation of the Mark II Azusa Tracking Equipment during a test shall be under the control of the Test Coordinator. Operating personnel shall advise him immediately of any condition of marginal or unsatisfactory operation considered to be detrimental to the successful completion of a test.

Upon completion of a test, and after re-calibration of recording equipment, operating personnel in charge of each system shall participate in a review of operations during the test. Any corrective action indicated as a result of this review shall be

effected as soon as possible in preparation for succeeding tests. Because of the variation in normal working hours and lunch periods between Engineering and the various supporting organizations, and to most efficiently utilize the working day without creating special problems, a 7:00 a.m. to 4:00 p.m. working day shall be observed by all personnel associated with the test program. Lunch period shall be from 12:00 noon to 1:00 p.m. The general routine for the day of a scheduled tracking test is as follows:

7:00 - 7:15 a.m.	Check readiness for application of Mark II power.
7:15 a.m.	Turn on Mark II power.
7:15 - 9:15 a.m.	System warm up.
9:00 a.m.	Direct aircraft become airborne and report for the test.
9:30 - 11:30 a.m.	Aircraft tracking test.
11:30 - 12:00 noon	Re-calibration of recording equipment. Digital data playback.
12:00 - 1:00 p.m.	Lunch
1:00 - 1:30 p.m.	Review of Mark II operation during test. Delivery of data and operating logs to System Parameters.
1:30 - 4:00 p.m.	Routine maintenance and preparations for succeeding tests.

5.3 Aircraft Transponders

Procedures applicable to the use of bailed or rental aircraft are presented. Basically, the differences between the two procedures are generated by the requirement to remove equipment from the rental aircraft after each day's test operations. It is assumed that bailed aircraft will be located at Lindbergh Field whereas rental aircraft will be located at Montgomery Field.

5.3.1 Bailed Aircraft

The transponder installation in the aircraft shall be checked the afternoon of the day prior to the day of a scheduled aircraft tracking test to verify satisfactory transponder system operation. Replacement, repair or adjustment of the transponder assembly scheduled for test use shall likewise be completed the day prior to a scheduled test. The Test Coordinator shall be advised of the status of the transponder assembly installation in the aircraft immediately after checkout of the transponder has been completed.

5.3.2 Rental Aircraft

The transponder assembly scheduled for test use shall be bench-tested the day prior to a scheduled tracking test and satisfactory operation under simulated conditions verified. The Test Coordinator shall be advised of the status of the transponder immediately after bench test of the transponder has been completed.

The transponder, inverter, and batteries (if required) shall

be installed and checked out in the aircraft on the day of the test, and operational status reported to the Test Coordinator by 8:45 a.m. on the day of the test.

After completion of a day's test activity, the transponder, inverter, and batteries shall be removed and returned to the transponder laboratories at Convair-Astronautics.

The Test Coordinator shall advise 551-5 personnel of transponder assembly performance during the test.

5.4 Transponder Test Towers

Two test towers will be employed during the test program to provide signals for checking performance of the Mark II Azusa Tracking Equipment under static test conditions - - the Water Tower located adjacent to Building 23, and a portable test tower to be located at a remote site as directed by the Test Coordinator. The Test Coordinator shall designate the test tower to be used for each test. Operation of the test towers shall be under the control of the Test Coordinator.

The performance of all equipment to be used at the designated test tower shall be determined on the day prior to a scheduled tracking test, and operational status reported to the Test Coordinator immediately after the completion of performance tests.

5.4.1 Portable Test Tower

When the portable test tower located at a remote site is scheduled to be used during a test, 551-3 System Integration personnel shall complete arrangements for required trans-

portation and equipment on the day prior to the scheduled test. If the remote site to be used is located on Camp Elliott, the Security Officer at Camp Elliott shall be contacted one day prior to a test to determine that the remote site area is available for our use on the day of the test. Availability of the remote site area shall be confirmed with the Security Officer at Camp Elliott at the time of entering Camp Elliott on the day of the test.

551-3 personnel responsible for operating the equipment at the remote site shall have the equipment operating on location within one hour after power is applied to the Mark II Azusa Tracking Equipment. Reports shall be relayed by radio communications to the Test Coordinator (1) upon arrival at the remote site, (2) when the transponder is turned on and off, and (3) when departing from the remote site. The radio channel designated for communications shall be continuously monitored by personnel at the remote site. Upon completion of a test, all equipment used at the remote site shall be returned to Building 23 for maintenance and storage until required for succeeding tests.

5.4.2 Water Tower

The signals radiated from the antenna on the Water Tower are fed from the MO-LO cabinet in Building 23. This is a fixed installation, and its use will be controlled by the Test Coordinator.

5.5 Communications

Three sets of voice communication equipment will be used during the test program - - one set for communications between the Mark II Azusa ground station and the aircraft, and two sets for communications between the Mark II Azusa ground station and the remote (portable) transponder test tower. The communication equipment will be operated by 551-3 personnel having valid FCC licenses as required by regulations of the FCC. The communication equipment operators shall be directly responsible for complying with applicable FCC regulations.

The use of communication frequencies assigned to Convair by the FCC is controlled by Mr. W. B. Harwell, Manager of Production Flight, Convair, San Diego Division. 551-3 System Integration personnel shall obtain Mr. Harwell's approval prior to scheduling the use of communication frequencies for a test.

The communication equipment operator shall maintain an operating log reflecting the following information:

Station call sign.

Operating power.

Operating frequency.

Time transmitter power is turned on.

Time and call sign of station(s) called, and instructions conveyed or information received.

Time Azusa transponder is turned on and off.

Time of CONELRAD alerts or test drills.

Time transmitter power is turned off.

The communication equipment shall be maintained by Dept. 756 personnel.

5.6 Aircraft

A schedule shall be prepared indicating the estimated number of flights by week required for the aircraft tracking test program. This schedule shall be supplemented on a weekly basis with a schedule indicating the dates and start times that aircraft are required to support the tracking test schedule. The weekly schedule shall be prepared, and include the pilot's approval, by Wednesday afternoon for the succeeding week's test activity. A week's schedule shall run from Monday through Saturday. Occasions will arise during the test program when it will be desirable to use the aircraft for a test as soon as arrangements can be effected. Such non-scheduled use shall be arranged with the pilot.

Whenever it becomes evident that it is not feasible to conduct a test as scheduled, the pilot shall be notified of test deferment and requirements for rescheduling.

The aircraft flight patterns required for each test shall be discussed with the pilot on the day prior to a scheduled test. The Test Coordinator shall be responsible for briefing the pilot.

Deviations required during the test, from flight patterns previously established, shall be relayed to the pilot via VHF communications.

As the aircraft flight patterns planned during the test program will require our aircraft to fly over the traffic patterns used by aircraft landing at, and taking off from, the Naval Air Station at

Miramar, it is considered appropriate to keep the Commanding Officer of the Naval Air Station advised of our scheduled aircraft operations; such notification shall be the responsibility of the Test Coordinator.

5.7 Test Equipment

All test equipment used in support of the test program shall be calibrated and maintained in accordance with Engineering Standards Laboratory procedures. Arrangements shall be made by 551-3 System Integration personnel with Engineering Standards Laboratory (532-4) to have faulty test equipment, or test equipment requiring re-calibration, serviced and returned to Building 23 within 24 hours after receipt of the equipment by 532-4.

5.8 Data Reduction, Analysis and Evaluation

All data recorded during a tracking test shall be delivered to the Test Coordinator who, after conducting a review of the test, shall deliver the data to 551-3 System Parameters personnel. System Parameters personnel shall deliver data requiring additional processing to 551-1 personnel. 551-1 personnel, with the assistance of 591-3 personnel, shall reduce the data using appropriate equipment in accordance with the requirements provided by System Parameters personnel. The reduced data shall be returned to System Parameters personnel for analysis and evaluation. Data analysis and evaluation shall be accomplished by System Parameters personnel with the assistance of 551-1 personnel, and a preliminary report of the test prepared and distributed within 72 hours after completion of the test.

System Parameters personnel shall maintain a log, by test, indicating data received, data forwarded, processed data received, and the identification and distribution of preliminary reports issued.

All raw data shall be retained and stored after use by System Parameters personnel.

It is anticipated that large quantities of data will be recorded during the test program - - particularly, digital data on magnetic tape. In view of the compressed time scale of the test program and the length of time required to reduce and analyze this type of data, System Parameters personnel shall carefully evaluate the validity, usefulness and extent of reduction required in arriving at a decision as to requirements for data reduction.

APPENDIX AExcerpts From The CONELRAD ManualGeneral

These regulations apply to all radio stations licensed by the Federal Communications Commission in the Experimental Radio Services located within the continental United States and are for the purpose of providing for the alerting and operation of radio stations in these services during periods of air attack or imminent threat thereof. The objective of these regulations is to minimize the navigational aid that an enemy might obtain from the electromagnetic radiations from radio stations in the Experimental Radio Services, while simultaneously providing for a continued radio service under controlled conditions when such operation is essential to the public welfare.

All radio stations in the Experimental Radio Services are required to make provisions to receive the CONELRAD RADIO ALERT and CONELRAD RADIO ALL CLEAR.

All radio stations in these services are required to either remain silent or operate under specified conditions and for authorized purposes during the period of a CONELRAD RADIO ALERT and until the CONELRAD RADIO ALL CLEAR is issued.

How the CONELRAD RADIO ALERT May be Received

Immediately upon receipt of the CONELRAD RADIO ALERT each standard, FM and TV broadcast station will proceed as follows on its normally assigned frequency:

- (a) Discontinue normal program.

- (b) Cut the transmitter carrier for approximately five seconds.
(Sound carrier only for TV stations)
- (c) Return carrier to the air for approximately five seconds.
- (d) Cut the transmitter carrier for approximately five seconds.
- (e) -Return carrier to the air.
- (f) Broadcast 1000 cycle (approximate) steady state tone for fifteen seconds.

- (g) Broadcast the CONELRAD RADIO ALERT MESSAGE as follows:

"We interrupt our normal program to cooperate in security and Civil Defense measures as requested by the United States Government. This is a CONELRAD RADIO ALERT.

Normal broadcasting will now be discontinued for an indefinite period. Civil Defense information will be broadcast in most areas at 640 and 1240 on your regular radio receiver."

- (h) The CONELRAD RADIO ALERT MESSAGE will then be repeated.

(a) through (f) above is for the purpose of attracting the listeners' attention, or, if desired, to operate an automatic alert receiver or warning device.

CAUTION: (a) through (f) is a warning that a CONELRAD RADIO ALERT may follow; the actual CONELRAD RADIO ALERT signal is the spoken word in the form of the CONELRAD RADIO ALERT MESSAGE.

The CONELRAD RADIO ALERT MESSAGE, as set forth in (g) above, is worded in a manner suitable for reception by the public; however, the message is also THE CONELRAD RADIO ALERT. When this CONELRAD RADIO ALERT MESSAGE is received,

all licensees must immediately comply with the CONELRAD operating procedure. The precise CONELRAD RADIO ALERT MESSAGE, above, will be broadcast only in the event of an actual "Alert". In the event of a CONELRAD test or drill, broadcast stations will make an announcement that a test or drill is taking place.

Radio station licensees operating radio systems consisting of several mobile units, portable, and/or fixed location stations may elect to receive the CONELRAD RADIO ALERT at only one point if desired; under such conditions, the licensee will be responsible for disseminating the "Alert" to the other units in the system, and for insuring that all units execute CONELRAD requirements immediately.

NOTE: Radio stations need not make arrangements to receive the "Alert" during periods that the station is not open for operation.

Caution should be used upon opening the station for operation to insure that a CONELRAD RADIO ALERT is not in progress.

Normal broadcast station operation or normal channel traffic will indicate that no "Alert" is in progress.

How Radio Stations Must Operate During A CONELRAD RADIO ALERT

Radio stations in the Experimental Radio Services, upon receipt of a CONELRAD RADIO ALERT, will interrupt any communications in progress, leave the air and maintain radio silence for the duration of the CONELRAD RADIO ALERT, except for the transmissions handled in accordance with the following restrictions:

- (1) No radio transmissions shall be made unless they are of an emergency

nature affecting the national safety or the safety of people and property.

The following types of messages are considered as permissible:

- (a) Relaying of the CONELRAD RADIO ALERT.
- (b) Transmissions involving the safety, security, or protection of equipment and materials.
- (c) Transmissions involving the safety of people.

All transmission not immediately necessary must be withheld until the CONELRAD RADIO ALL CLEAR.

(2) All transmissions must be as short as possible and the carrier shall be removed from the air during periods of no message or intelligence transmissions.

(3) No station identification shall be given, at any time after the alert is received, either by announcement of regularly assigned call signals or by announcement of geographical location.

How the CONELRAD RADIO ALL CLEAR May be Received

The CONELRAD RADIO ALL CLEAR can be received through the same channels as the CONELRAD RADIO ALERT is received.

When the CONELRAD RADIO ALL CLEAR is issued each standard, FM and TV broadcast station will transmit 15 seconds of 1000 cycle tone beeps then transmit the following CONELRAD RADIO ALL CLEAR MESSAGE:

"The CONELRAD operating procedures have been ordered discontinued. All radio stations are authorized to return to normal operation on their regularly assigned frequencies."

"I repeat" -

"The CONELRAD operating procedures have been ordered discontinued. All radio stations are authorized to return to normal operation on their regularly assigned frequencies."

Observations indicating broadcast stations are operating in a normal manner will indicate that a CONELRAD RADIO ALL CLEAR is in effect.

Radio stations and systems licensed in the Experimental Radio Services may resume normal operation when the CONELRAD RADIO ALL CLEAR message is received unless otherwise restricted by order of the Federal Communications Commission.

Tests

Tests of the CONELRAD alerting and operating systems may be conducted at appropriate intervals. Stations not normally in operation during the period of a test will not be required to take part.

Tests of the CONELRAD operating system will not require Experimental radio stations to close down and will be conducted in a manner that will not interfere with normal transmissions.

Reports of the results of such tests may be required in a form to be prescribed by the Commission.

Record Entries

Appropriate entries of all CONELRAD tests and operations shall be made in the station records.