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LOCKHEED

Q-5

high supersonic drone system

PROGRAM PLANNING REPORT

NUMBER 10

15 APRIL 1957

MISSILE SYSTEMS DIVISION
VAN NUYS, CALIFORNIA

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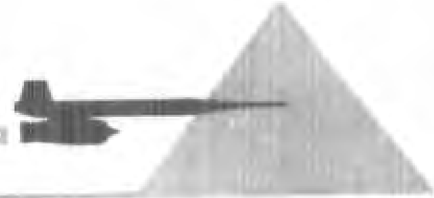
Q-5



HIGH SUPERSONIC DRONE SYSTEM

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LMSD SSD-FD
DATED 7-29-63
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PROGRAM PLANNING REPORT

LMSD-1008-10
15 APRIL 1957

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MISSILE SYSTEMS DIVISION • VAN NUYS, CALIFORNIA

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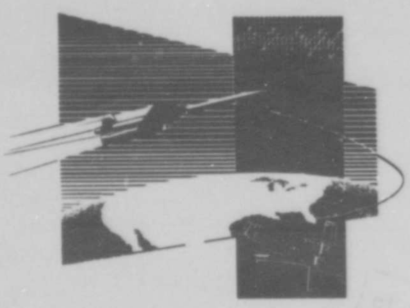

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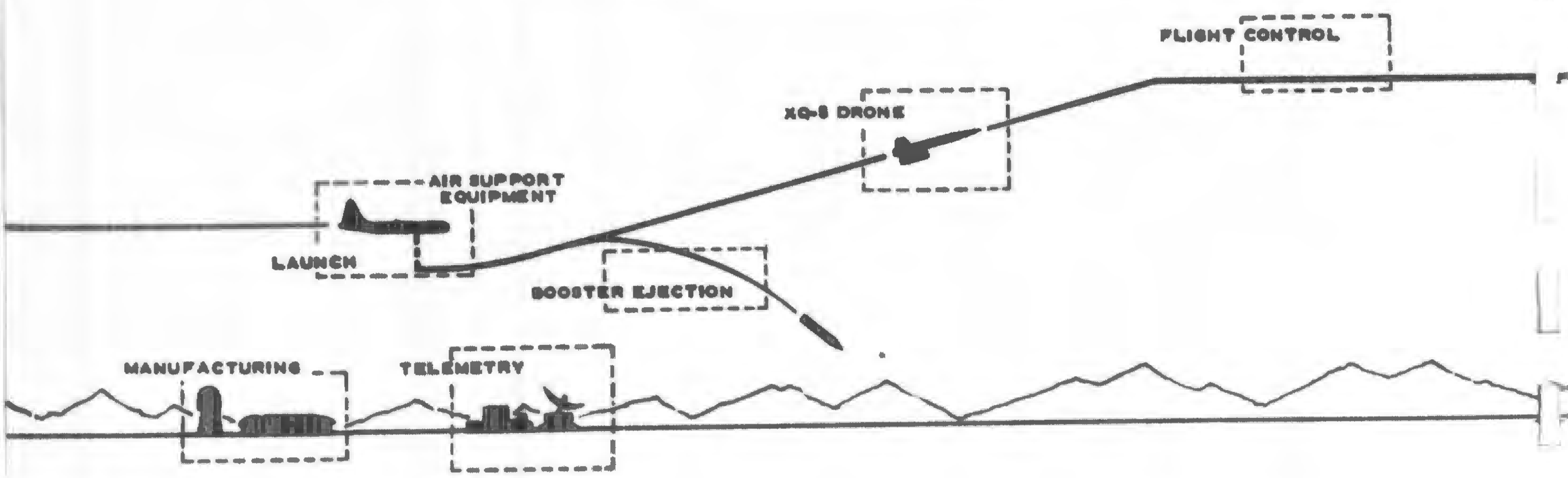
OPERATIONAL REQUIREMENTS

Operating Altitude:	80, 000 Ft.
Speed:	Mach 2. 7 at Altitude
Effective Guidance Range:	100 N. Mi. at Alt.
Maneuverability:	3g at Altitude
Duration of Controlled Flight:	10 Min.

DESIGN FEATURES

Target Area Augmentation
Firing Error Indication
Recovery on Land or Water

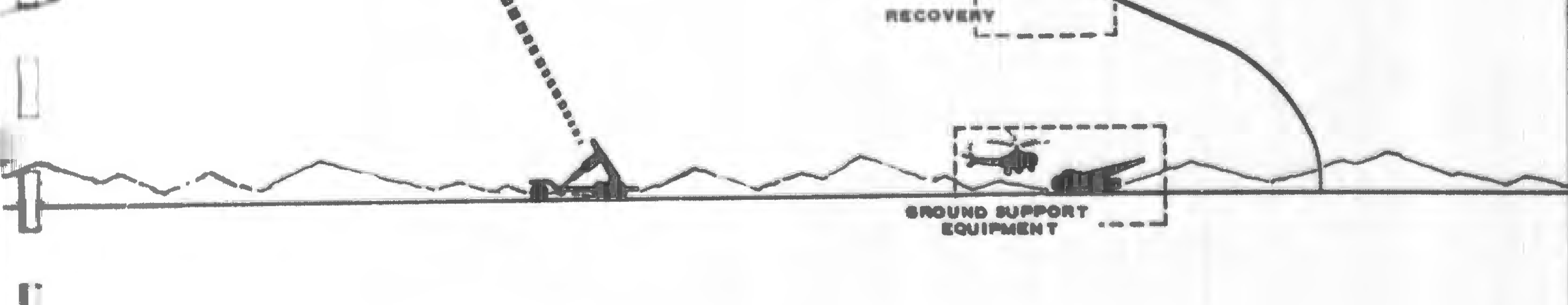


INTRODUCTION

The program planning report is issued quarterly to inform and assist the Air Research and Development Command of the Air Force and the Missile Systems Division of the Lockheed Aircraft Corporation in the direction and control of the development of the XQ-5 Drone and the Q-5 Drone System and to plan for the early integration of the Q-5 Drone System into effective operational service.

Although specific items are dated as to time of actual or intended accomplishment, all dates subsequent to the date of this report are tentative. The contractor intends to inform the procuring agency of the nature and reasons for specific changes.

The XQ-5 Research and Development Program is being conducted under contract No. AF 33(600)27591.



XQ-5 DRONE

The objective of the XQ-5 Research and Development Program is to provide a high supersonic drone capable of sustained flight at Mach 2.7 at 80,000 ft. altitude. The drone is to be air launched, boosted to flight speed, maintained at flight speed with a ramjet engine, and successfully recovered. The XQ-5 Drone is intended to serve as a model for the drone to be used in the Q-5 Drone System for the development and service-testing of, and training for, interceptor weapons systems.

The basic elements of the XQ-5 Drone and associated equipment comprise the drone, a launch aircraft, ground support equipment, and training equipment.

Because of the operating limitations of the MA-20F-4 Ramjet Engine the performance characteristics of the drone are as follows:

Speed: Mach 2.2 to 2.7.

Operating Altitude: 65,000 ft. (max.).

Duration of Controlled Flight: 9 Min. at 60,000 ft.

Maneuver Capability: 2.2 g at 60,000 ft.

Q-5 DRONE SYSTEM PROGRAM PLAN

A program plan for the specific objective of realizing an operationally suitable Q-5 Drone System by 1960 is outlined on the opposite page. Development, manufacturing, operations and supporting study effort presently recognized as essential to attaining this objective are summarized on the opposite page and explored in greater detail on subsequent pages. Plans to meet the XQ-5 program contractual commitments and the developmental requirements of the Q-5 Drone System are combined.

The XQ-5 Drone is derived from the X-7A Ramjet Test Vehicle developed by Lockheed. The XQ-5 Drone is structurally related to the X-7A Ramjet Test Vehicle and the X-7B Guidance Test Vehicle. Tests and studies made in support of the X-7B program were in many cases directly applicable to the XQ-5.

The following symbols will be used on succeeding graphs to denote time span and dates.

WORK UNDER CONTRACT

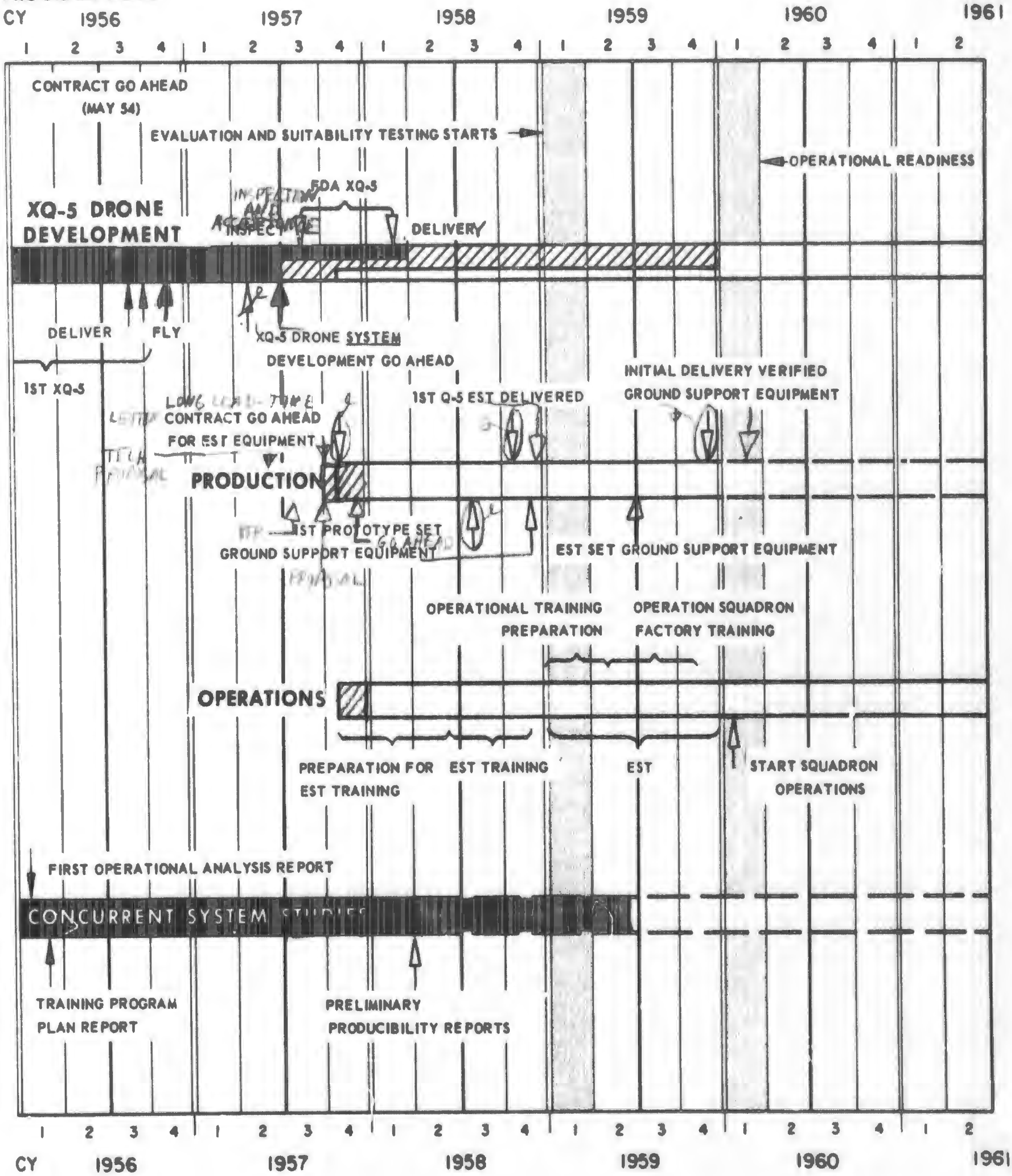
PLANNED IMMEDIATE FOLLOW-ON

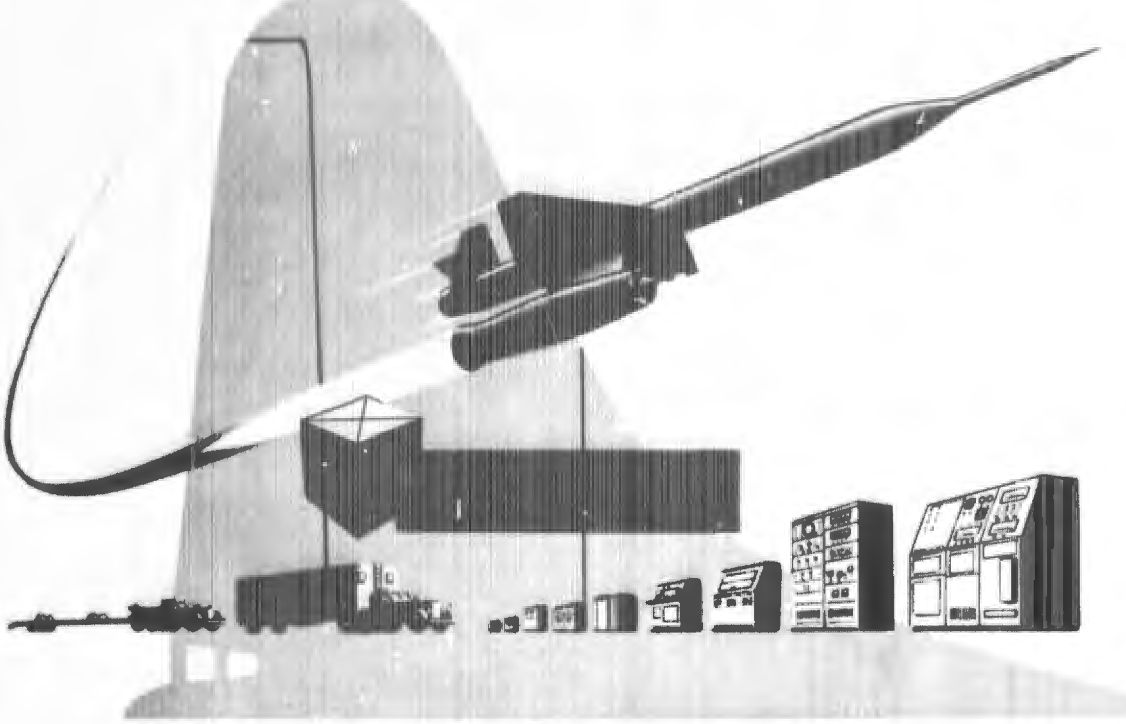
FUTURE PLANNING

ACTION PLANNED

ACTION COMPLETED (OR EVENT)

Q-5 DRONE SYSTEM PROGRAM PLAN





SYSTEM DEVELOPMENT

The development phase of the Q-5 Drone System program plan covers the study, design, application of existing equipment or principles, fabrication and testing of each item which must be developed for the system.

In addition to the basic system development, further refinements of the system permitting the incorporation of continuing product improvement effort is planned as indicated by extensions to the basic development schedules.

The major elements of the drone system are programmed in summary form on the opposite page. Detailed planning for the major subsystem of these elements is presented on succeeding pages.

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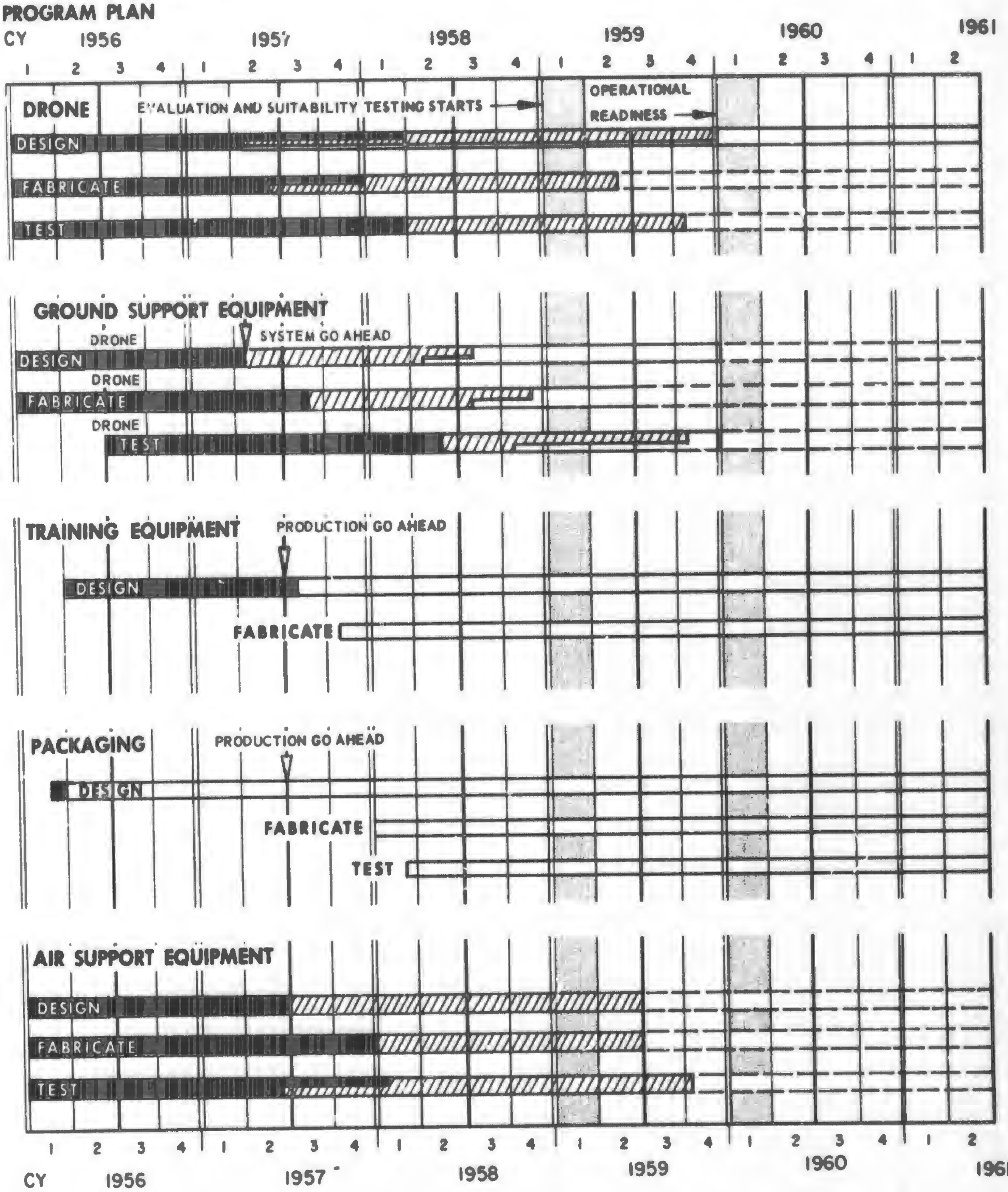
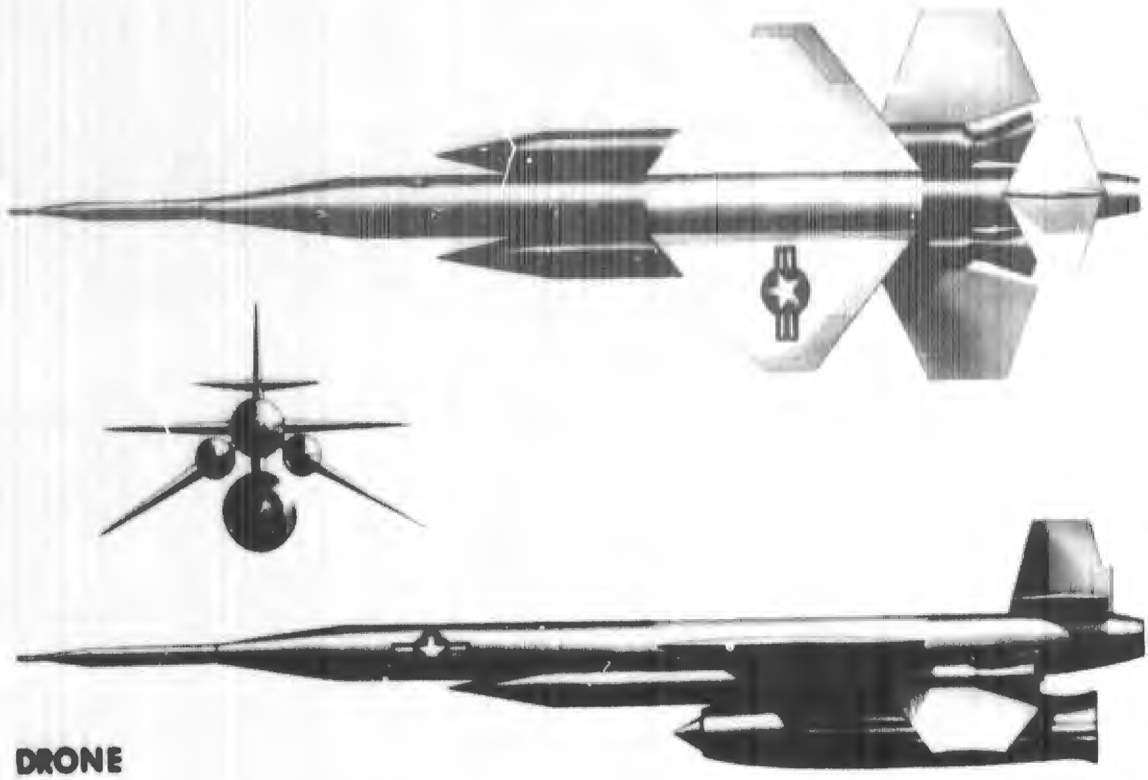
SYSTEM DEVELOPMENT PROGRAM PLAN





DRONE

The XQ-5 Drone embodies a tapered wing and conventional tail surface arrangement. The fuselage is of pressure-sealed sections of monocoque construction.

DRONE DESIGN

Gross Weight (less boosters)	3954 lb.
Length	38.5 ft.
Wingspan	10.0 ft.
Height	7.4 ft.
Boost Thrust Source	Two 5KS-50,000-lb.-thrust booster rockets
Flight Thrust Source	MA-20F-4 ramjet engine (GFAE)

The functional subsystems housed within the drone airframe are fuel, command guidance, flight control, electrical, refrigeration and pressurization, firing error indicator, target area augmentation, recovery and telemetry.

For a definitive description of the XQ-5 Drone refer to Lockheed Report No. 9524, "Manufacturer's Detail Model Specification for the XQ-5 High Supersonic Drone".

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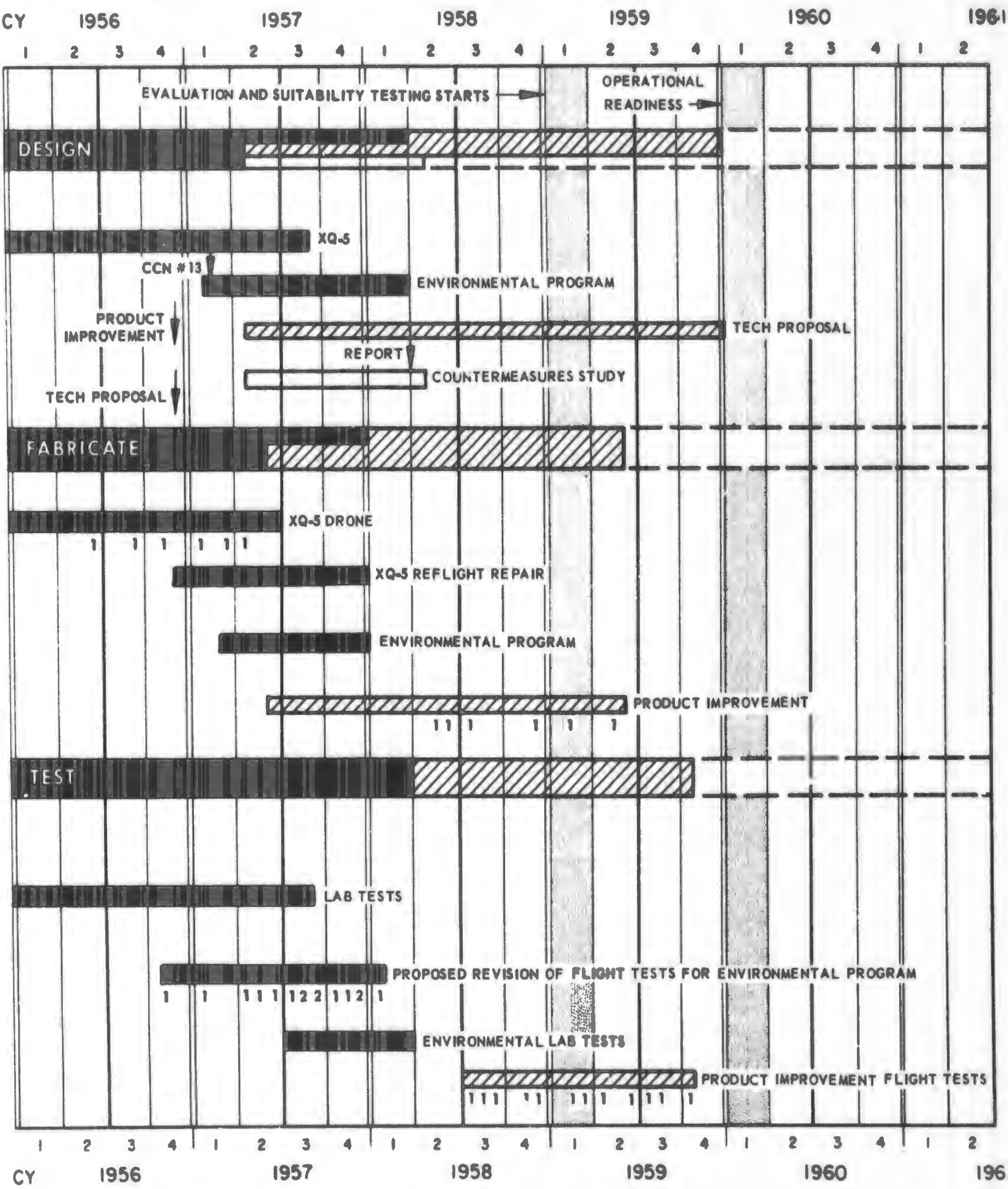
DRONE DEVELOPMENT PROGRAM PLAN



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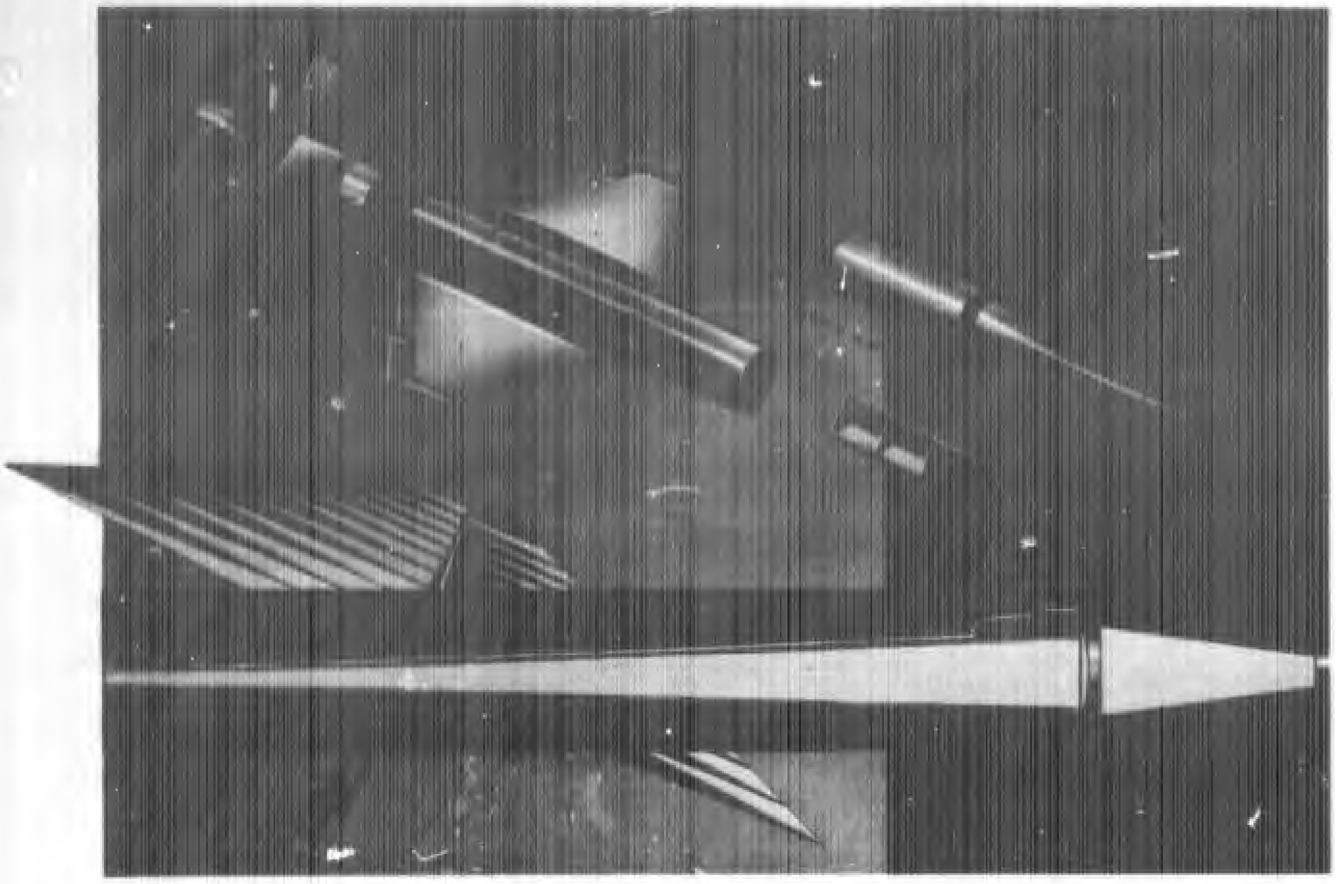


Airframe

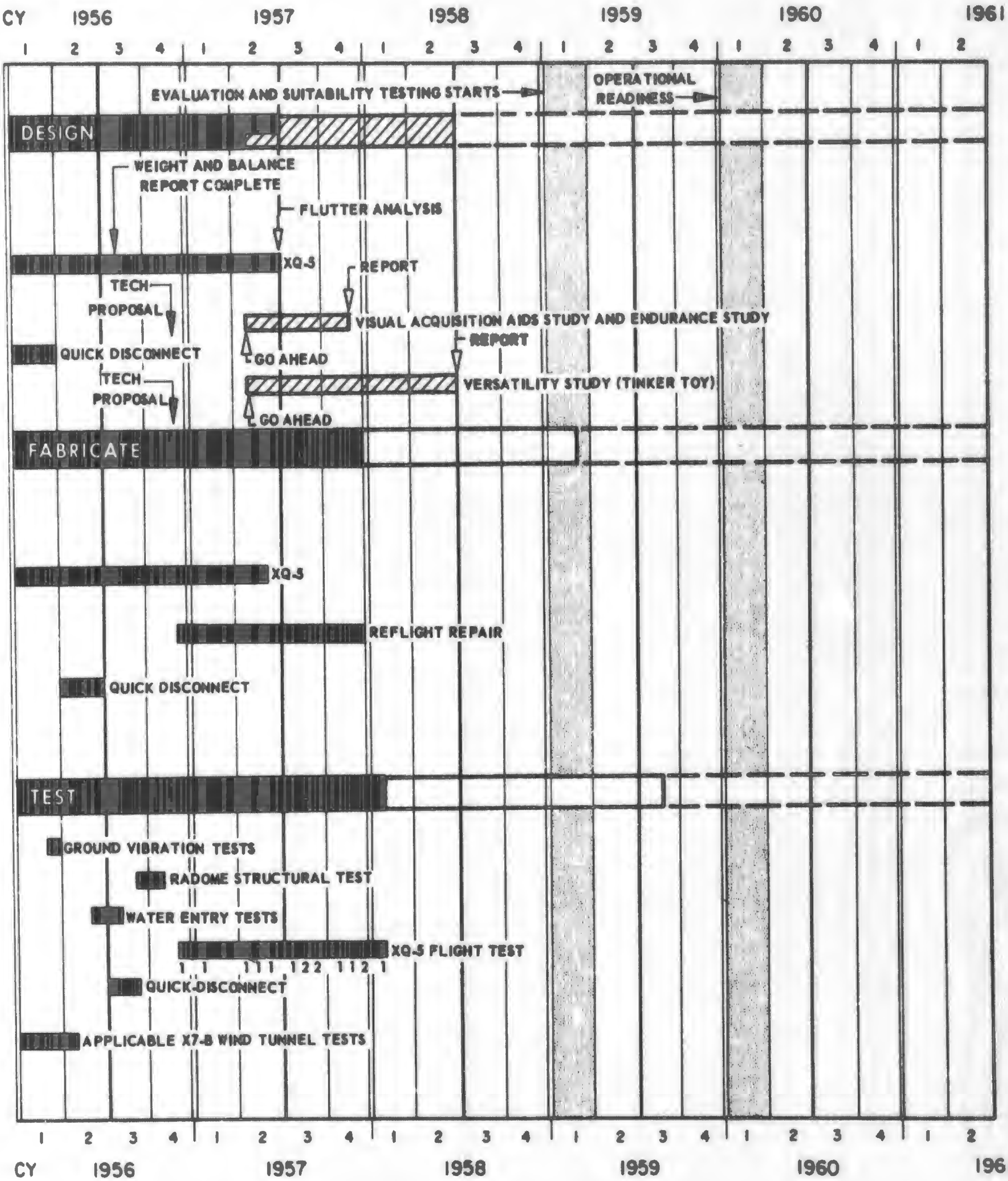
The XQ-5 Drone airframe is a derivative of the airframe developed for the X-7A Ramjet Test Vehicle, and is similar in construction to that of the X-7B Guidance Test Vehicle. Much of the data gained in static-test analyses in the X-7B program are directly applicable to the XQ-5 development, and many parts used in the two vehicles are identical.

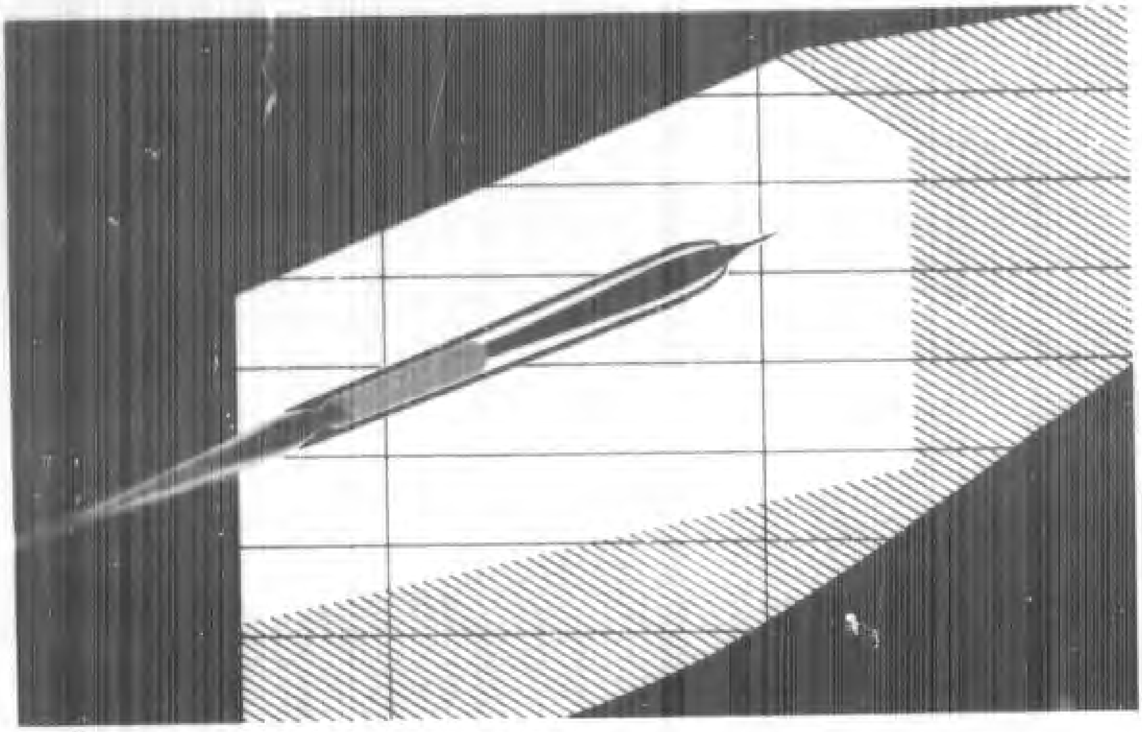
The airframe has three major sections. The forward section consists of a recovery spike and a nose cone made up of a radome (forward) portion and a steel after portion. The mid section is a two-section steel monocoque fuselage that supports the wings and ramjet engine. The after fuselage is of steel semi-monocoque construction and supports the vertical fin, elevator, drag brake and parachute doors. The forward, middle and after sections of the fuselage, up to the parachute compartment, are pressure sealed. The drone airframe is structurally capable of ground launch.

The wings, vertical fin, booster fins and elevator are basically of sheet-over-rib construction. An aileron is attached to each wing.

A booster-ejecting Y-gun, part of the mid-fuselage structure, supports two underwing boost-thrust rockets. Each booster is provided with a fin and a nose cone.

AIRFRAME DEVELOPMENT PROGRAM PLAN





Propulsion

Propulsion is furnished by an externally mounted ramjet engine, which is controlled and supplied with fuel by elements housed in the drone fuselage. Initial thrust to engine ignition speed is obtained from externally mounted rocket boosters.

RAMJET ENGINE. A ramjet engine, Marquardt Aircraft Company Model No. MA-20F-4, is attached to the under side of drone mid-fuselage. Application of this engine is being made jointly by the XQ-5 Drone and X-7B Guidance Test Vehicle development programs.

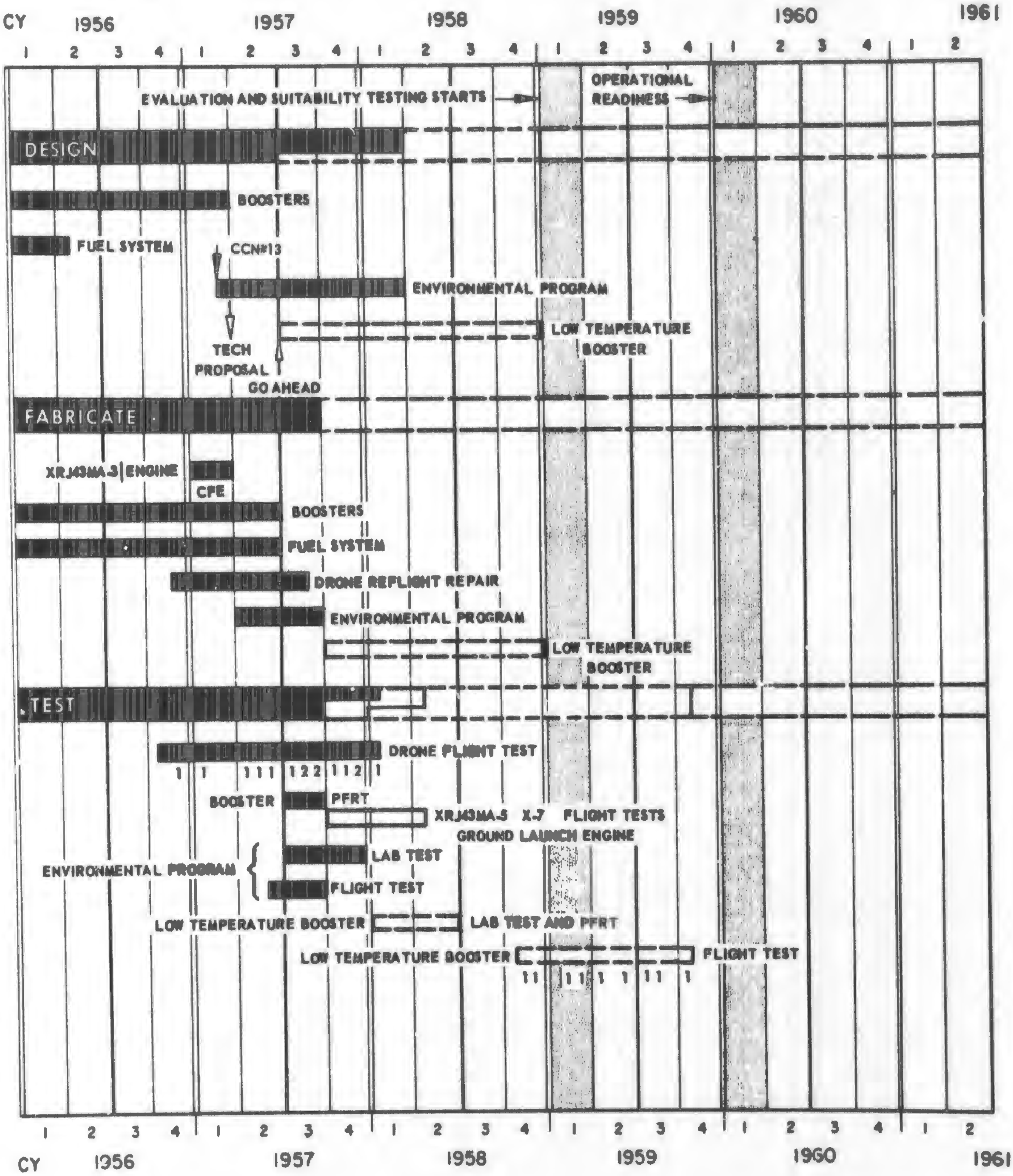
Early in 1955, Lockheed Report No. MSD-1056, "General Performance Specification for a 28-Inch Supersonic Ramjet Engine", was submitted to ARDC in a joint effort by the two projects to obtain an engine capable of meeting the military requirements for these vehicles.

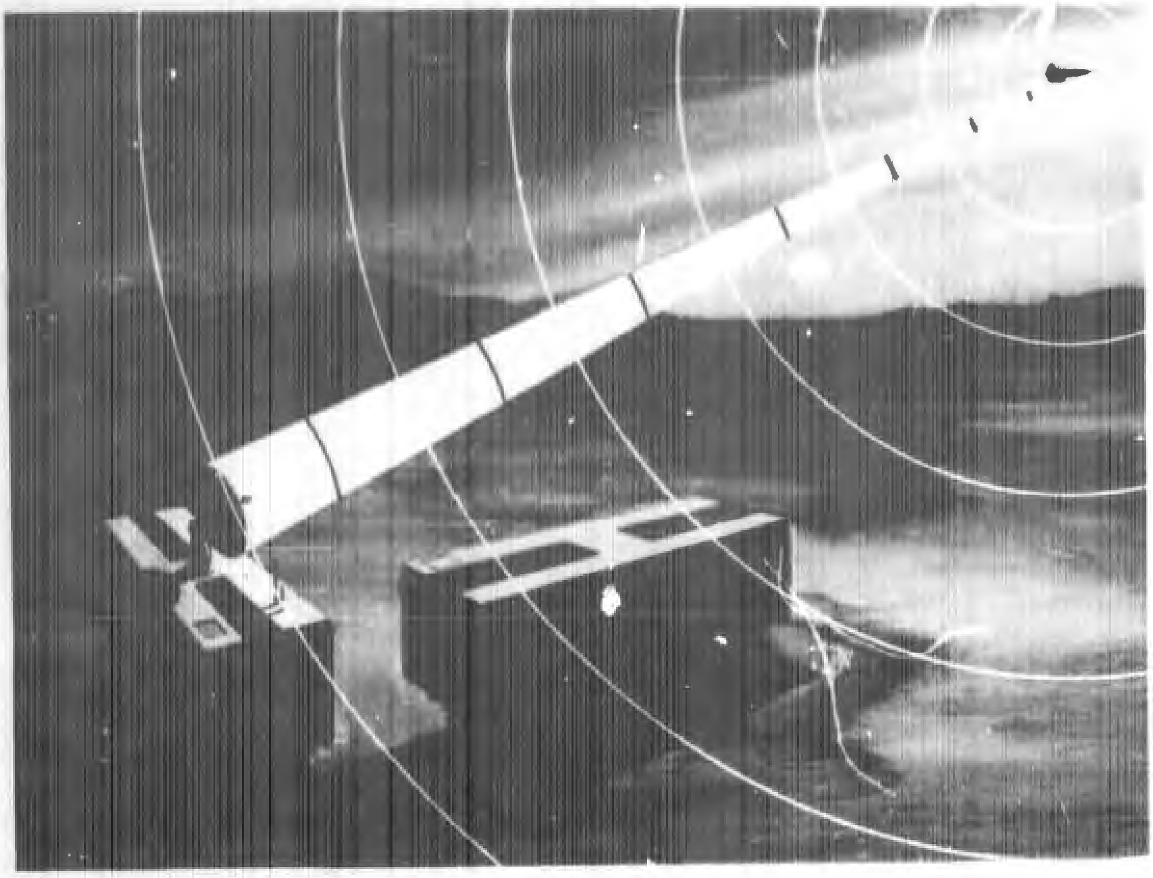
FUEL SYSTEM. The fuel system comprises two tanks from which the fuel is forced at 95 to 105 psia pressure by inflatable nitrogen pressurization bags. The fuel system nitrogen reservoir also supplies pressure to the fuel tank of the turboalternator and its accumulator on developmental drones No. 4 through 6. The drone carries 154 gal. of 80 octane fuel. The system incorporates a fuel cut-off and dump system which is operated when the drone recovery system is actuated.

BOOSTERS. One 5KS-50,000-lb.-thrust solid-propellant booster rocket of the type developed under the Lockheed X-7B Guidance Test Vehicle program is mounted under each wing by means of the Y-gun structure in the drone mid-fuselage. Immediately upon burn-out the boosters are ejected outward and downward by a powder charge in the Y-gun.

One fin, developed in the X-7B program, is attached to each booster to provide stability. A nose cone, a derivative of that developed in the X-7B program, is attached to each booster to accommodate electrical connections, igniters, and pressure switches.

PROPULSION DEVELOPMENT PROGRAM PLAN





Command Guidance

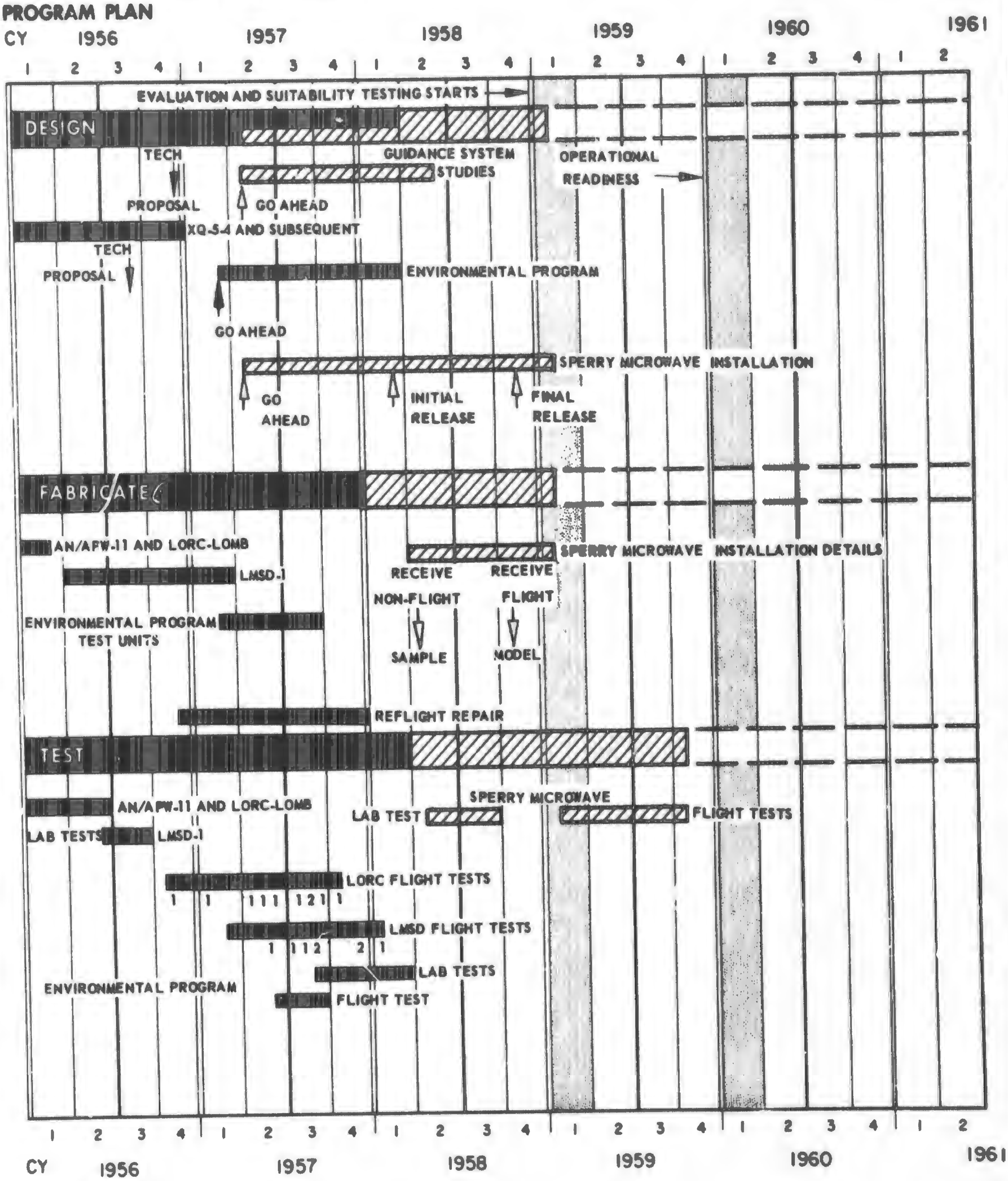
The drone's command guidance unit is part of the system control loop which consists of the ground controller, the airborne and ground command guidance unit, the target flight control unit, and the tracking radar.

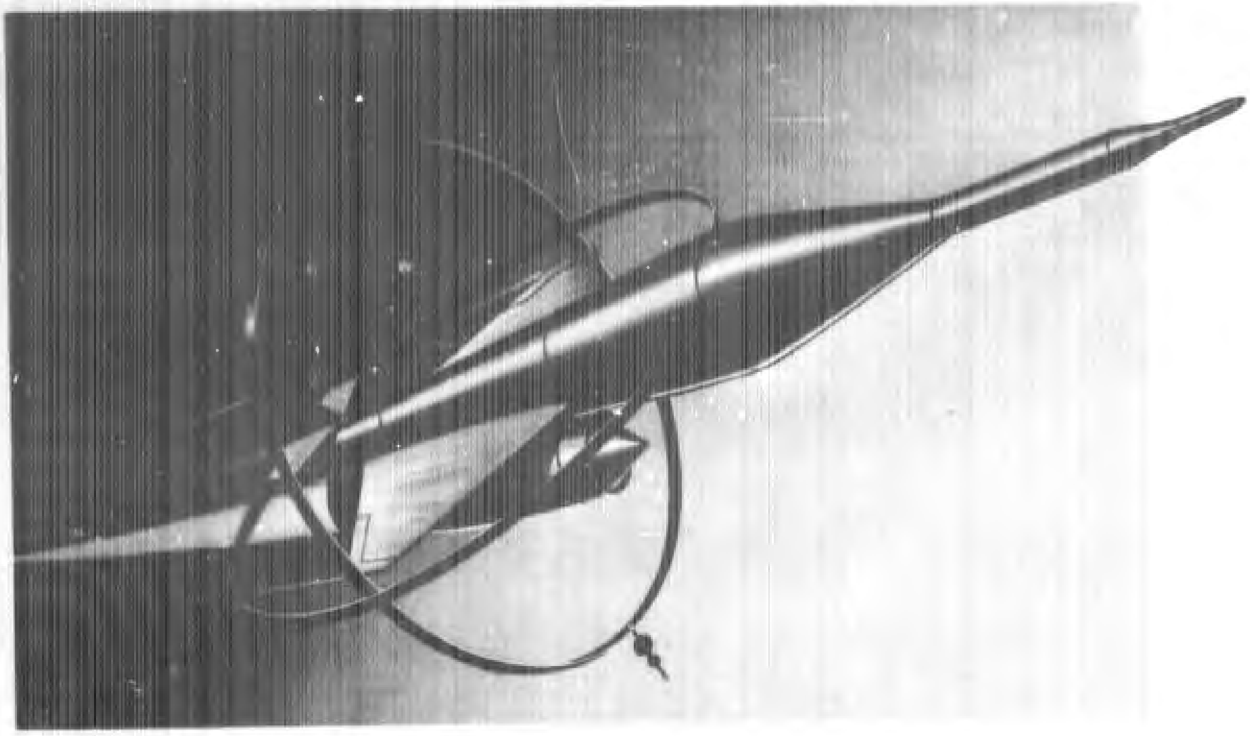
The command guidance utilizes a combination beacon-guidance system. The beacon receives pulse-position modulated signals from the ground radar and feeds them into the guidance system decoder circuit. The beacon return signal for the radar is transmitted from a separate set of antennas. Each command guidance system consists of a receiver-decoder, a command selector unit, a transmitter, and a power supply.

Upon receipt of a correctly coded signal the receiver-decoder generates trigger pulses and control tones. The control tones are fed through the command selector to the flight control and recovery systems. The trigger pulses are fed to the beacon transmitter which feeds the transmitting antennas.

Originally the command guidance systems for the first three developmental drones were to use the modified AN/APW-11A System incorporating an AN/DPN-19 Beacon used in the X-7A Ramjet Test Vehicle. This system has been eliminated and a new system is currently under study. This new system is an interim measure and comprises an AN/DPN-19 Tracking Beacon and a modified DRW-3 Command Control Receiver System. The command guidance system for the fourth and subsequent developmental drones will use a Lockheed system (tentatively designated AN/APW-21) incorporating an AN/DPN-17 Beacon.

COMMAND GUIDANCE DEVELOPMENT PROGRAM PLAN





Flight Control

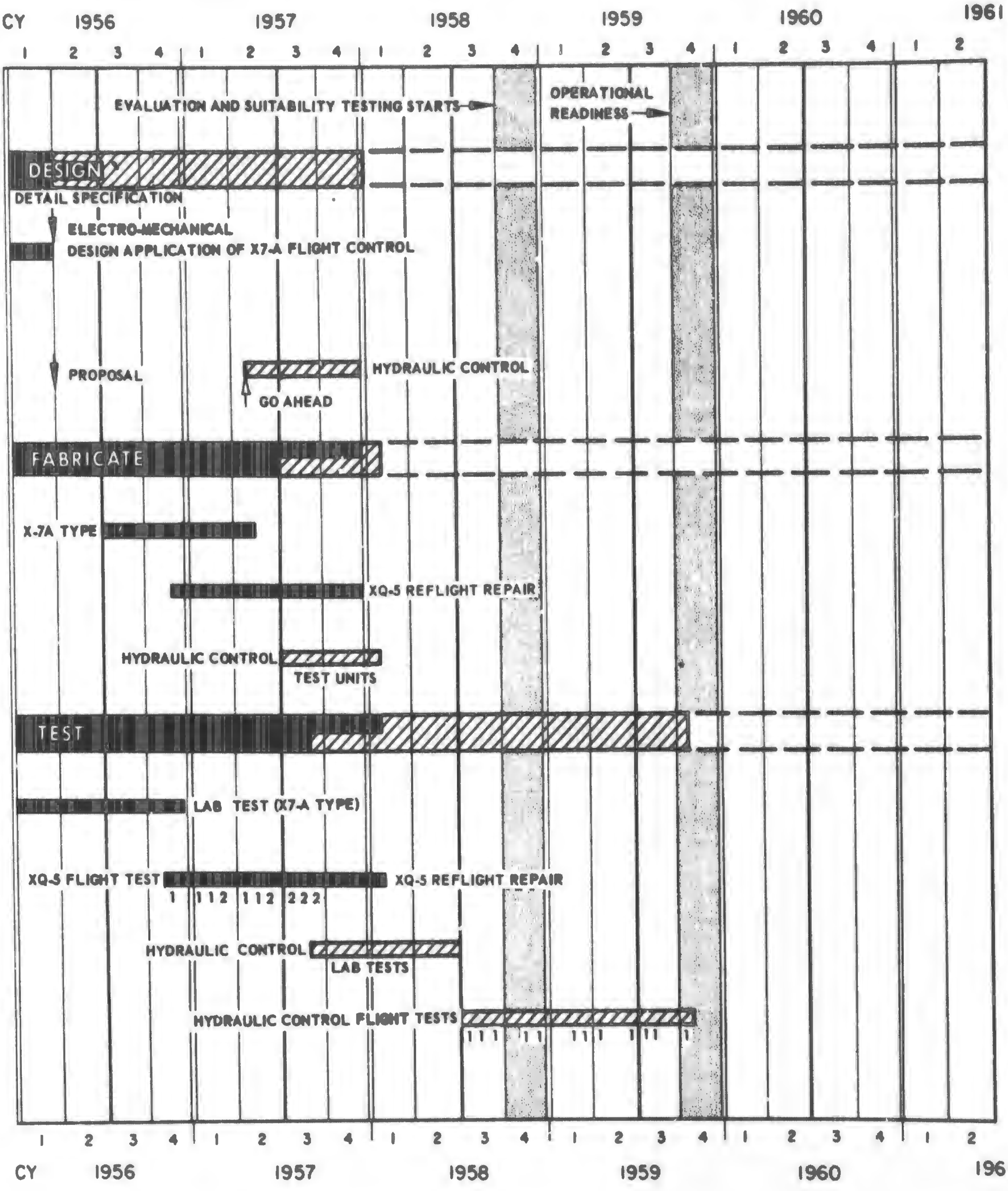
The flight control system stabilizes the drone about its pitch and roll axes, controls flight maneuvers in response to ground commands and limits the loads imposed on the drone by flight maneuvers. Upon ground command it controls the drag brake to limit flight speed to prevent exceeding the engine design speed. Yaw stabilization is provided by the inherent damping characteristics of the drone airframe.

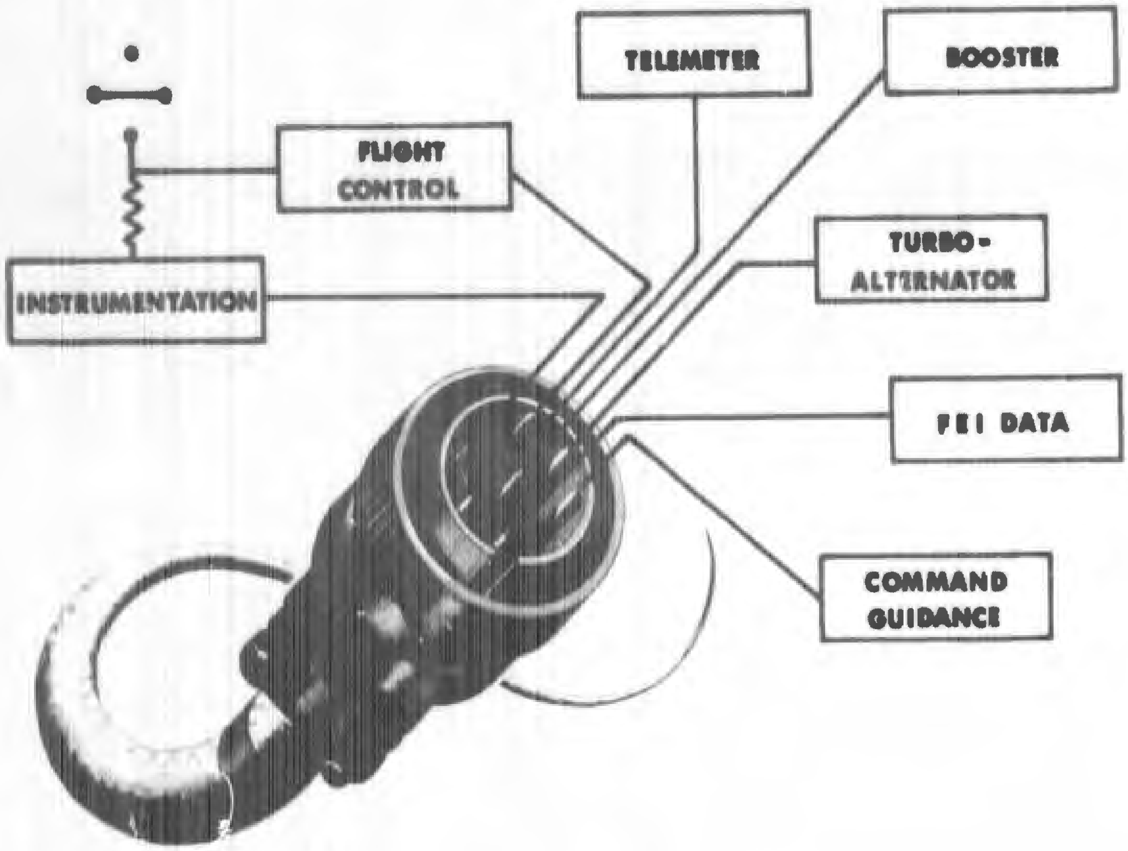
The flight control is an electromechanical system comprising a gyro cradle, an altitude control module, a pitch-roll servoamplifier module, a power supply module, a relay box, and the elevator and aileron servos.

The system is basically an adaptation of that developed for the X-7A Ramjet Test Vehicle. The major modifications to the X-7A system are the addition of directional and altitude systems and redesign of the elevator servosystem to make it nonreversible.

A flight control system incorporating hydraulically driven servomechanisms has been proposed in Lockheed Report No. MSD-1702, "Engineering Proposal for a Hydraulic Flight Control System."

FLIGHT CONTROL DEVELOPMENT
PROGRAM PLAN





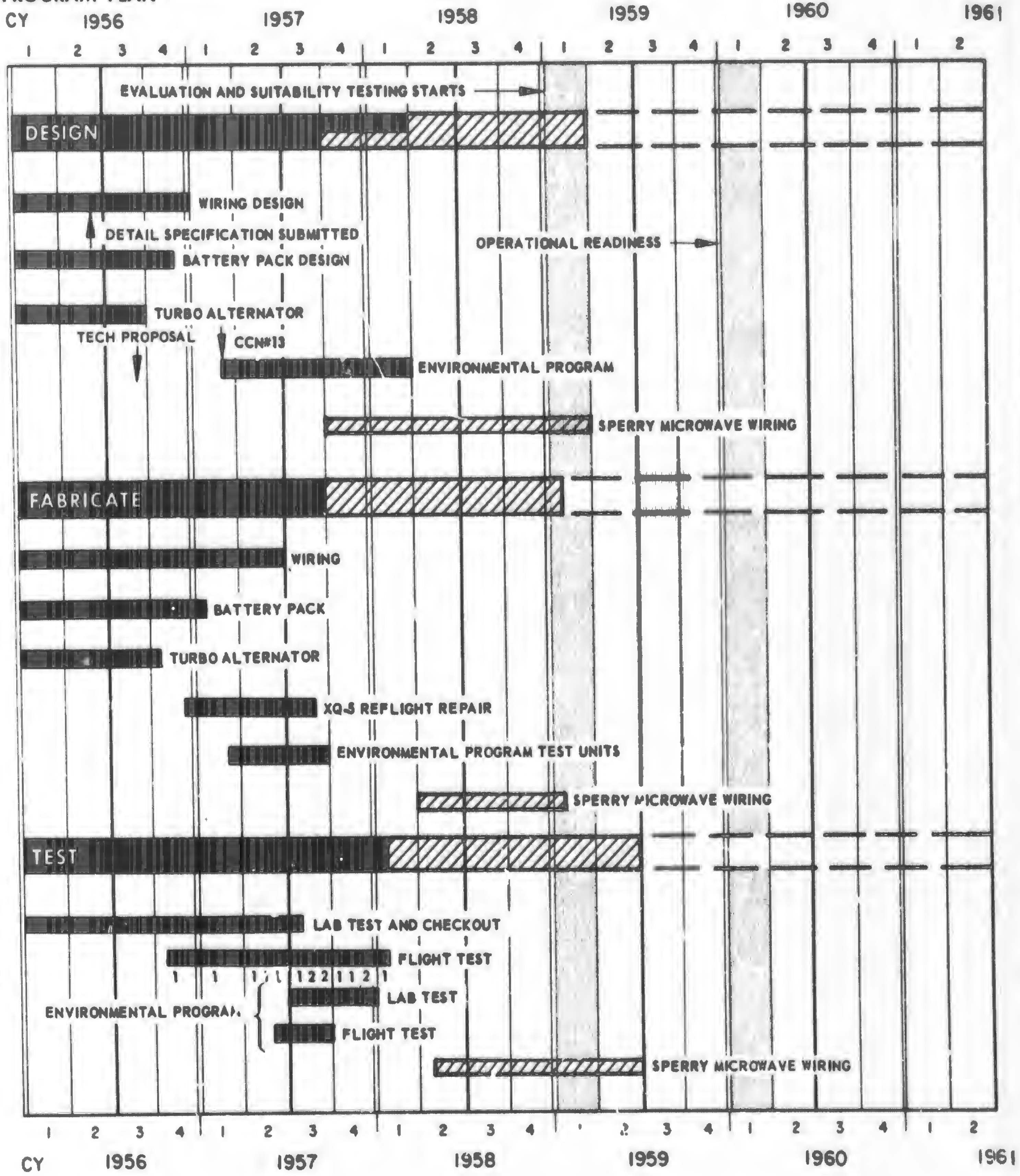
Electrical

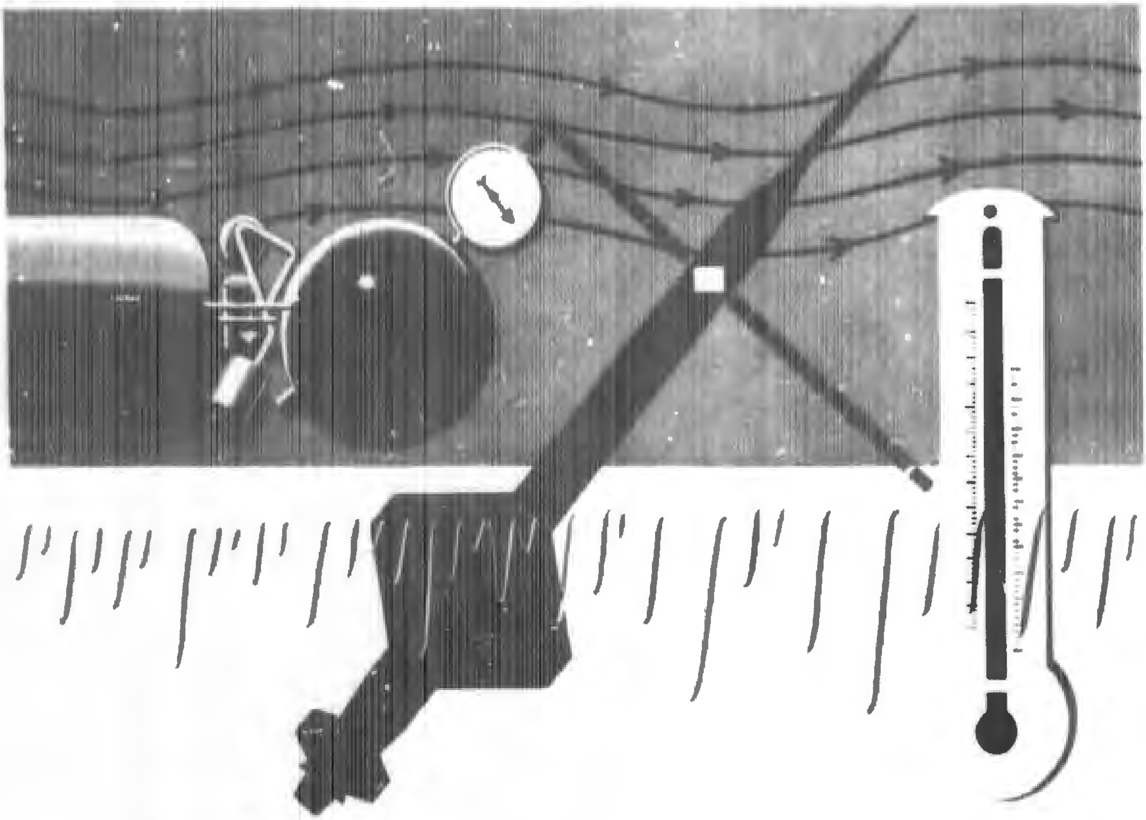
The electrical system consists of a power supply and the wiring harnesses that interconnect systems within the drone and connect the booster nose cones and the ramjet engine to the drone. The booster ejection timing switches, the altitude pressure sensing and acceleration switches, and the booster ignition squibs are parts of the electrical system.

The electrical and electronic circuits in the first six developmental drones are powered by batteries. A turboalternator power unit is under development for use in later drones. This turboalternator consists of an ethylene-oxide-driven turbine and alternating-current generator. Pressurization of the turboalternator fuel tank for fuel feed is accomplished by taking off pressure from the engine fuel system nitrogen pressurization system. Voltage and frequency regulation and the ability to receive commands to control operations are contained in control assembly integral with the turboalternator.

Electrical circuitry for recovery is an independent system and incorporates a separate set of batteries in all drones.

ELECTRICAL DEVELOPMENT PROGRAM PLAN





Refrigeration and Pressurization

The temperature control system comprises an axial blower, a heat-exchange labyrinth and ducting to provide recirculated coolant gas at approximately 100°F to operating systems within the drone.

Prior to launch the drone fuselage is pressurized from the nitrogen pressurization system in the launch aircraft. This pressure is maintained through the sublimination of the solid carbon dioxide (dry ice) used to form the labyrinth in the temperature control system. A positive differential pressure when the drone plunges into the water is assured by use of remaining nitrogen in the fuel pressurization system.

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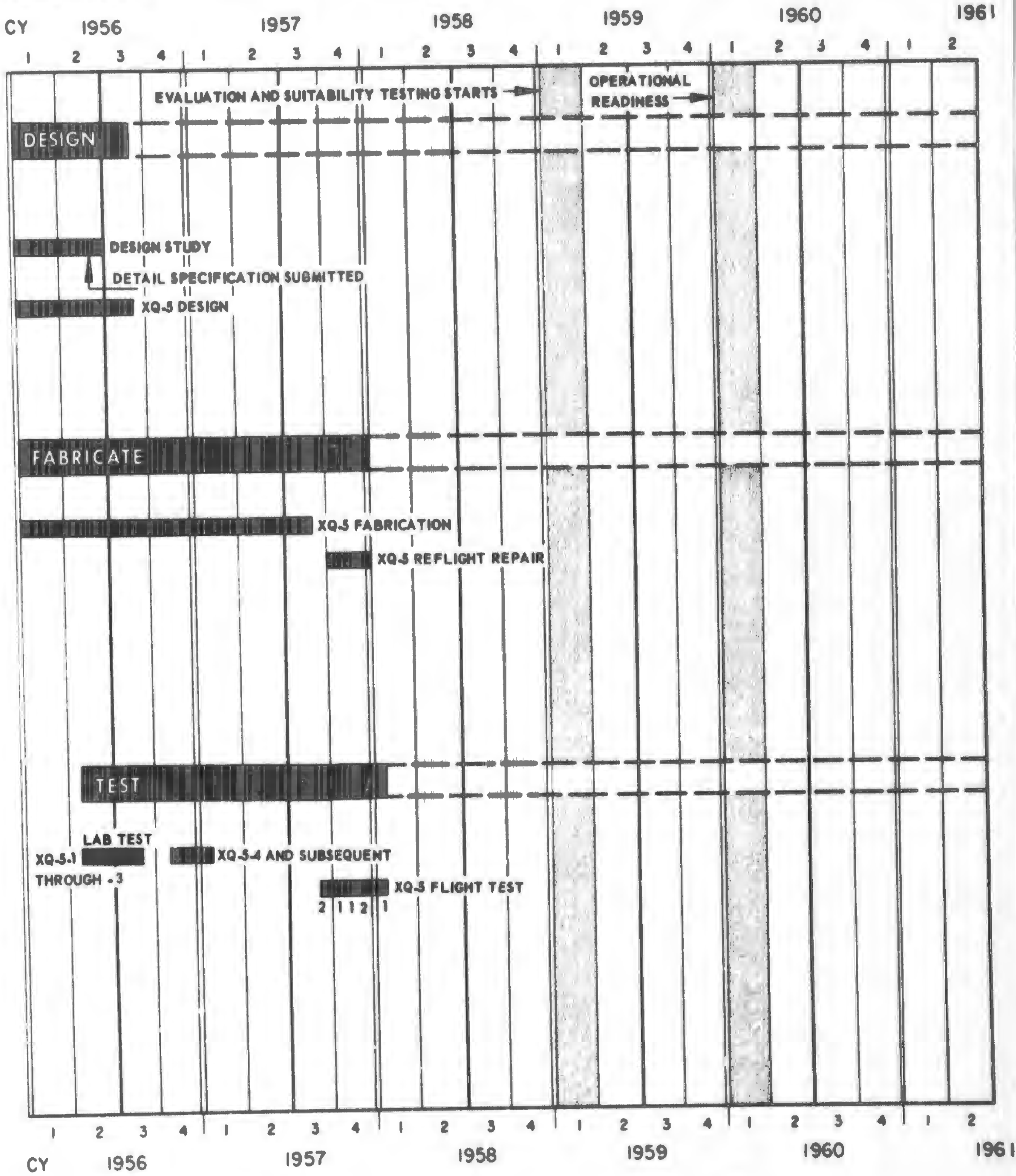
REFRIGERATION AND PRESSURIZATION DEVELOPMENT PROGRAM PLAN



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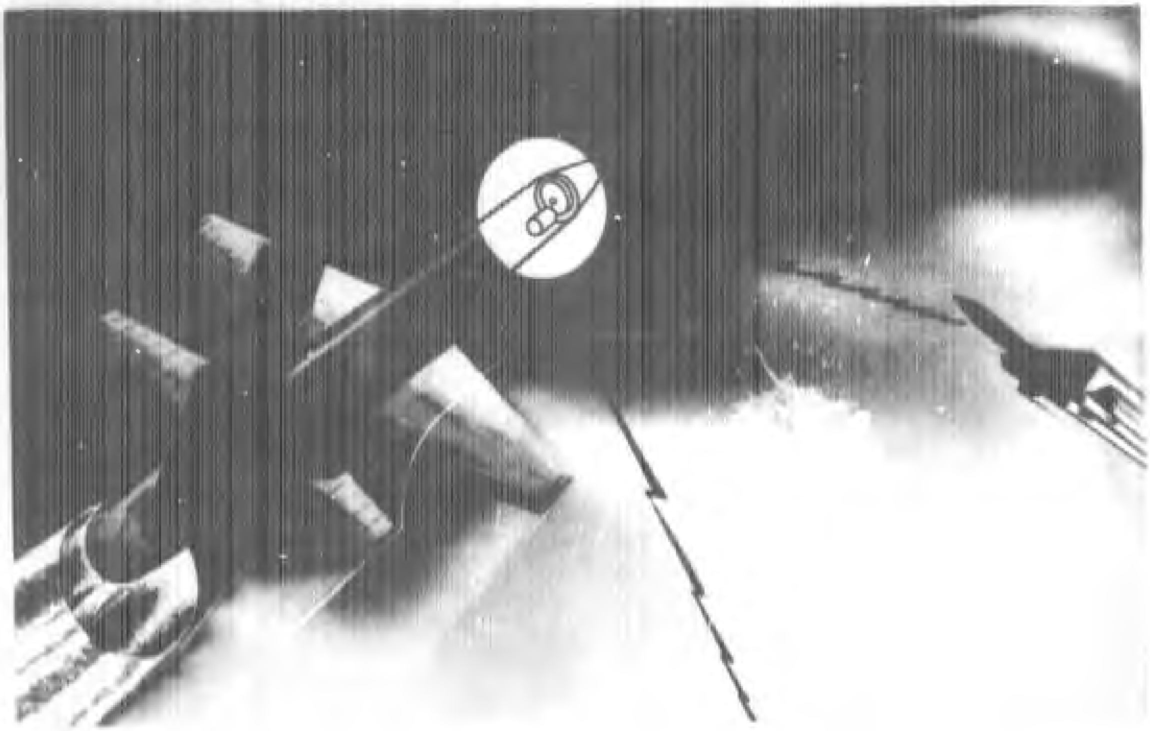


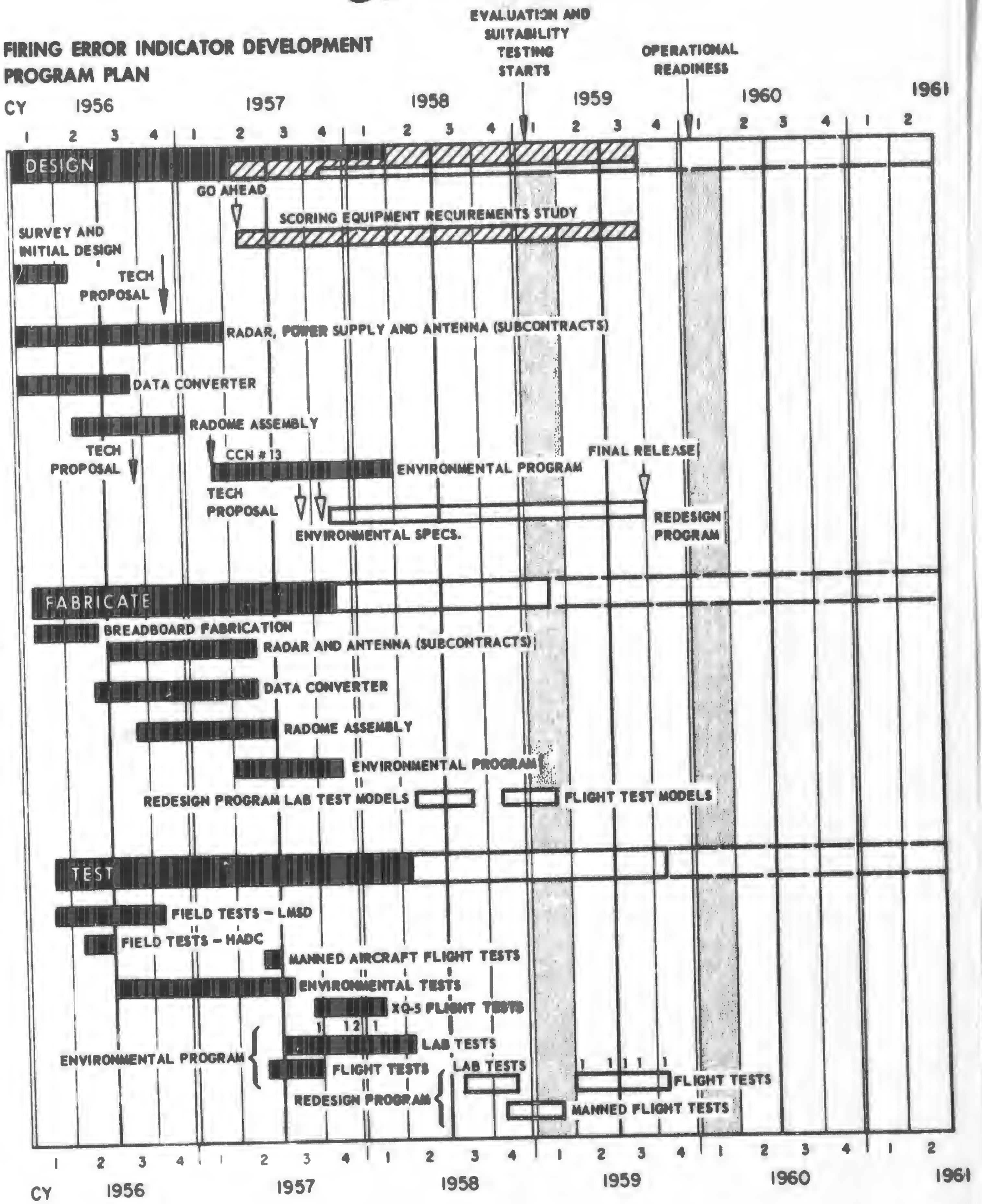
Firing Error Indicator

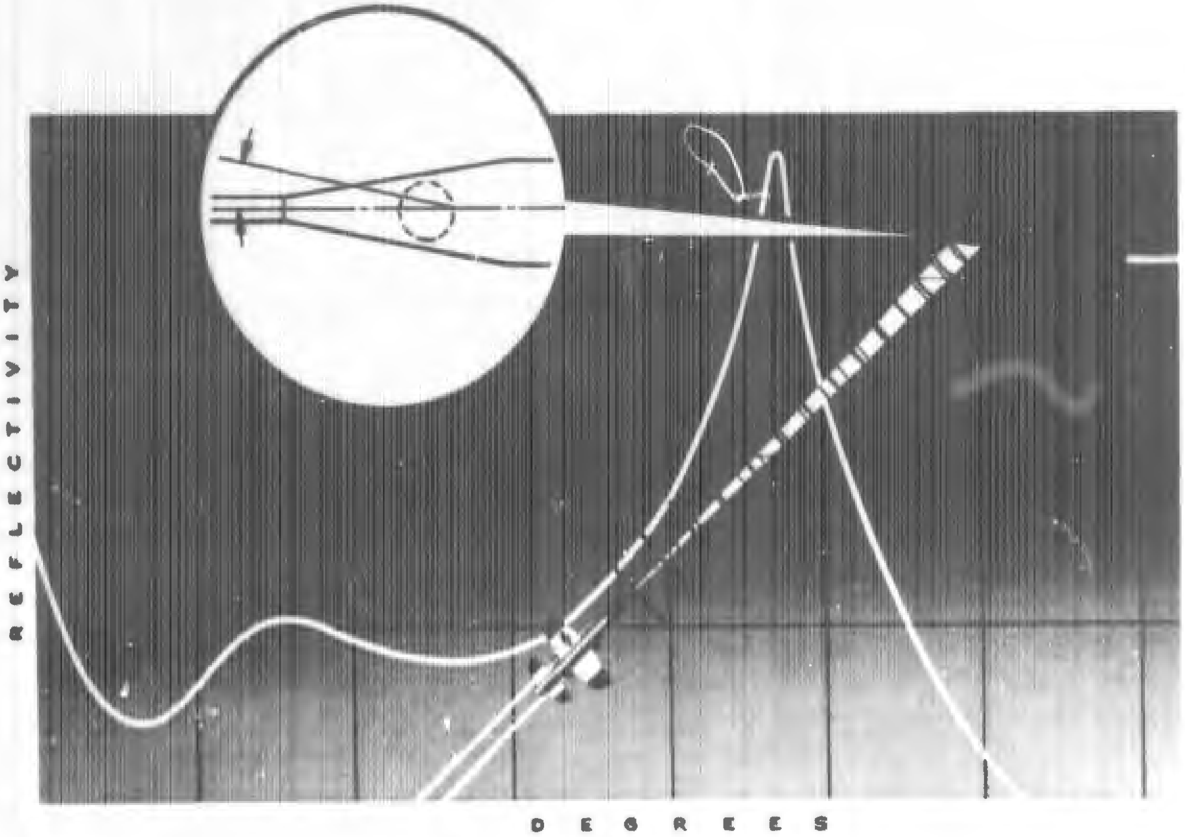
The firing error indicator (FEI) obtains data defining the distance and bearing between the drone and the interceptor missile and supplies this data in suitable form to the telemeter system for transmission to the ground. It comprises waveguides, radar, antenna and data converter elements.

The short-pulse radar is a low-power, short-range type. The antenna consists of an antenna horn, a feed structure, and a drive motor and resolver. The antenna rotates 360° radially with respect to the fuselage fore-aft axis. The data converter contains provisions for antenna pattern detection, range detection and storage.

Capability for any interceptor missile of radar cross section of 10 sq. ft. or larger.
Range: 100 ft. min., 1500 ft. max. (± 10%).
Radio Frequency: X Band.
Weight: 70 lb.

FIRING ERROR INDICATOR DEVELOPMENT PROGRAM PLAN





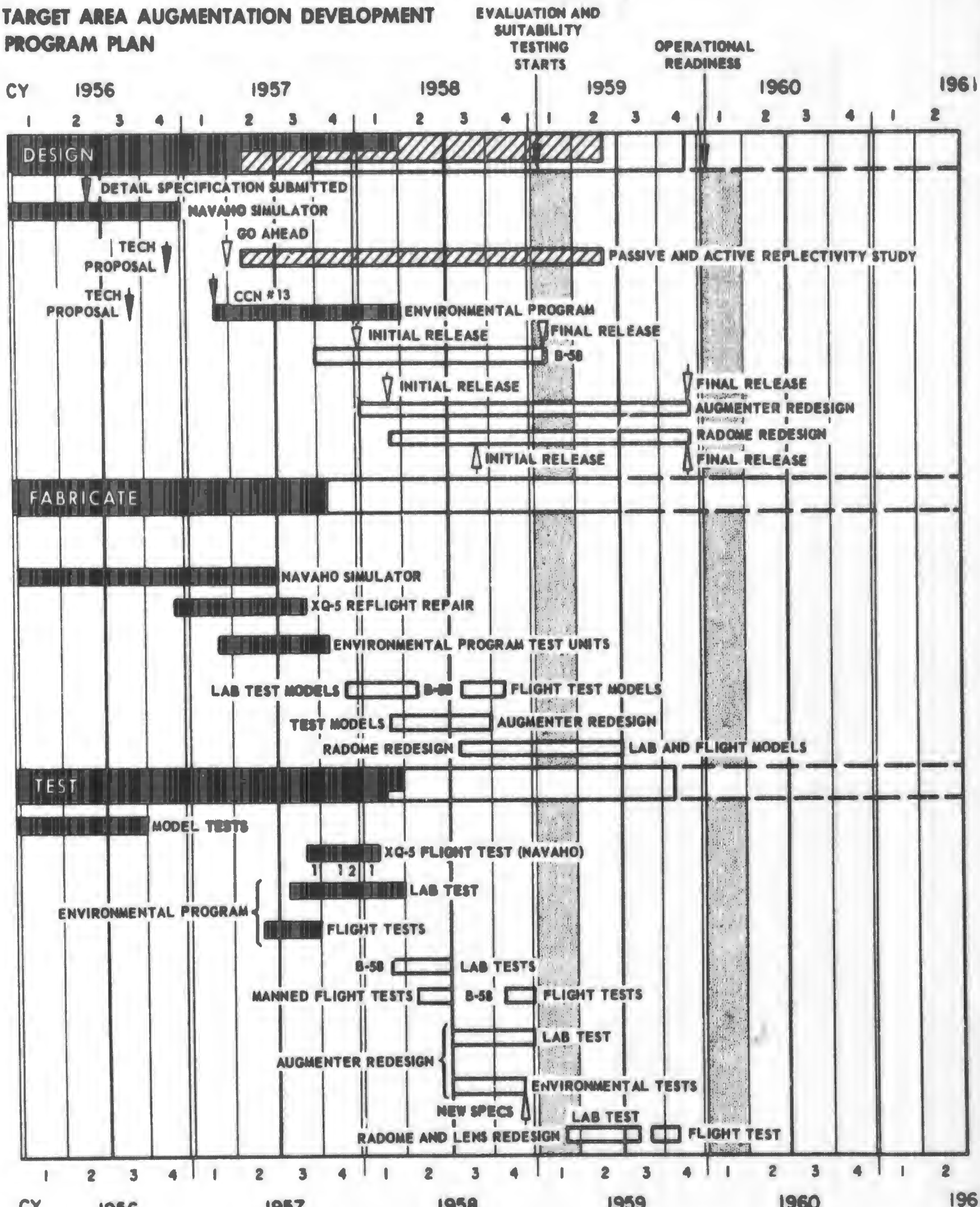
Target Area Augmentation

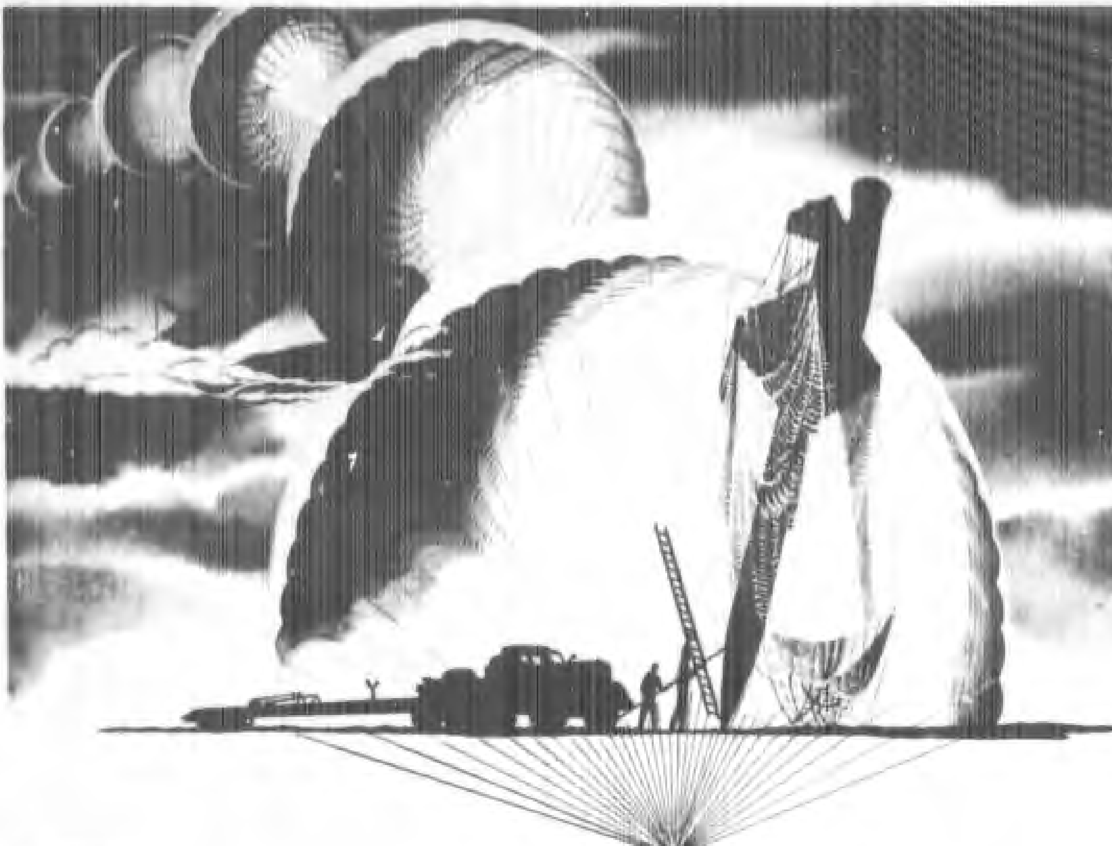
The target area augmentation (TAA) unit acts as a magnifying reflector of radar pulses transmitted by the intercepting missile thus enlarging the apparent frontal area of the drone. By this method the drone appears to the intercepting missile to be as large as a missile the size of the Navajo.

The augmenter consists of a Luneberg lens made of Eccofoam, enclosed in a glass-fiber covering, and a reflector.

Preliminary investigations of a means to increase the target area augmentation to provide a simulated drone frontal area equal to that of a Model B-58 Aircraft are being discussed with the Air Force. A Lockheed proposal for the development of a target area augmentation system to simulate the frontal area of a B-58 Aircraft is being prepared.

TARGET AREA AUGMENTATION DEVELOPMENT PROGRAM PLAN





Recovery

The recovery system comprises a parachute system with a separate electrical power supply and circuitry to actuate parachute door and parachute release by means of pyrotechnic squibs. A ground penetration spike provides shock absorption for safe land recovery and the drone's inherent flotation characteristics provide for safe recovery from water.

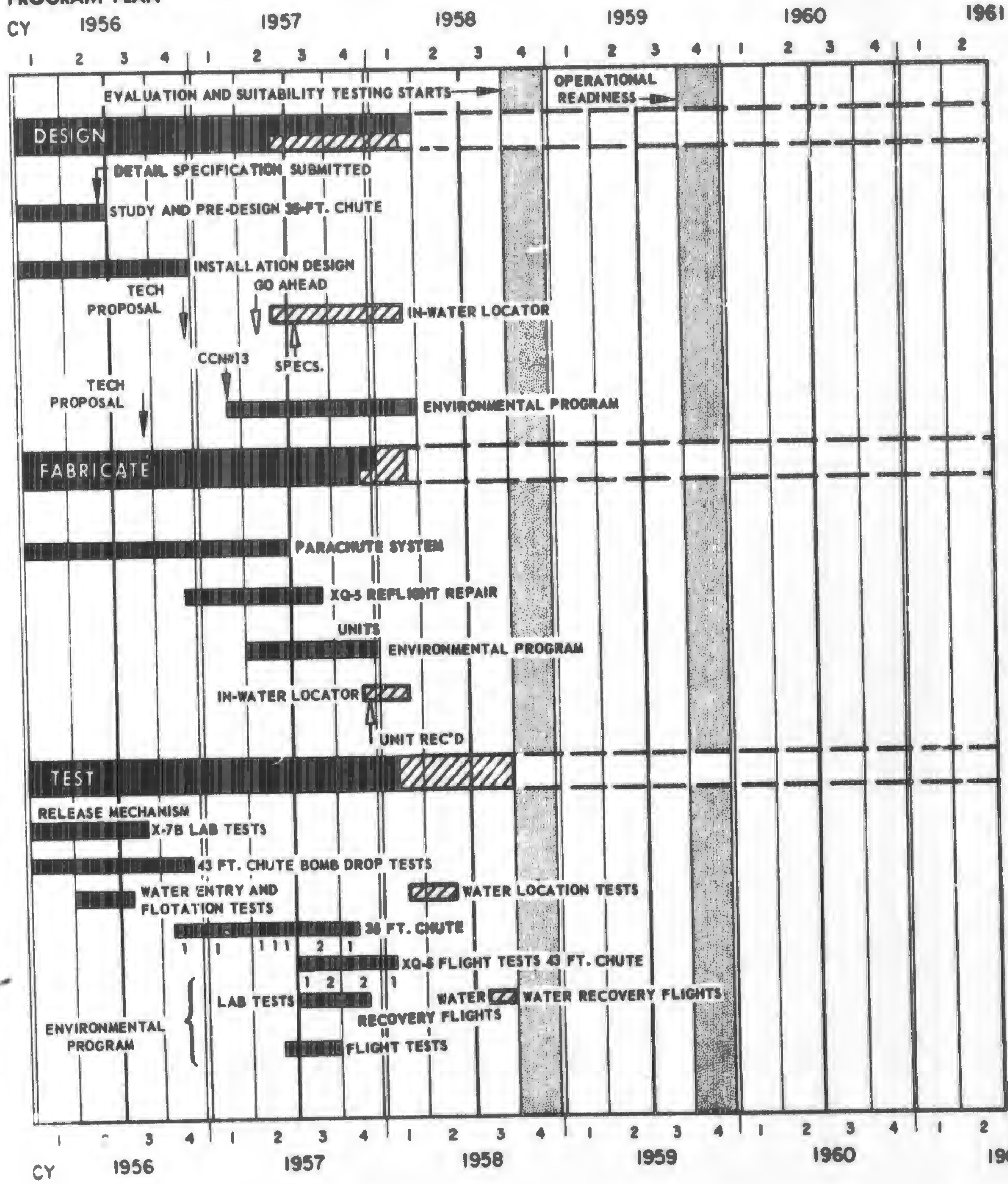
The recovery sequence is initiated by command or protracted loss of command while the drone is in flight at any altitude, or by pressure altitude switches when the drone descends below 20,700 ft. At this altitude circuits are closed to cut off engine fuel, jettison the remaining fuel. The drag parachute is deployed at 18,500 ft. Another set of altitude pressure switches initiate main parachute deployment after a further descent to 12,500 ft.

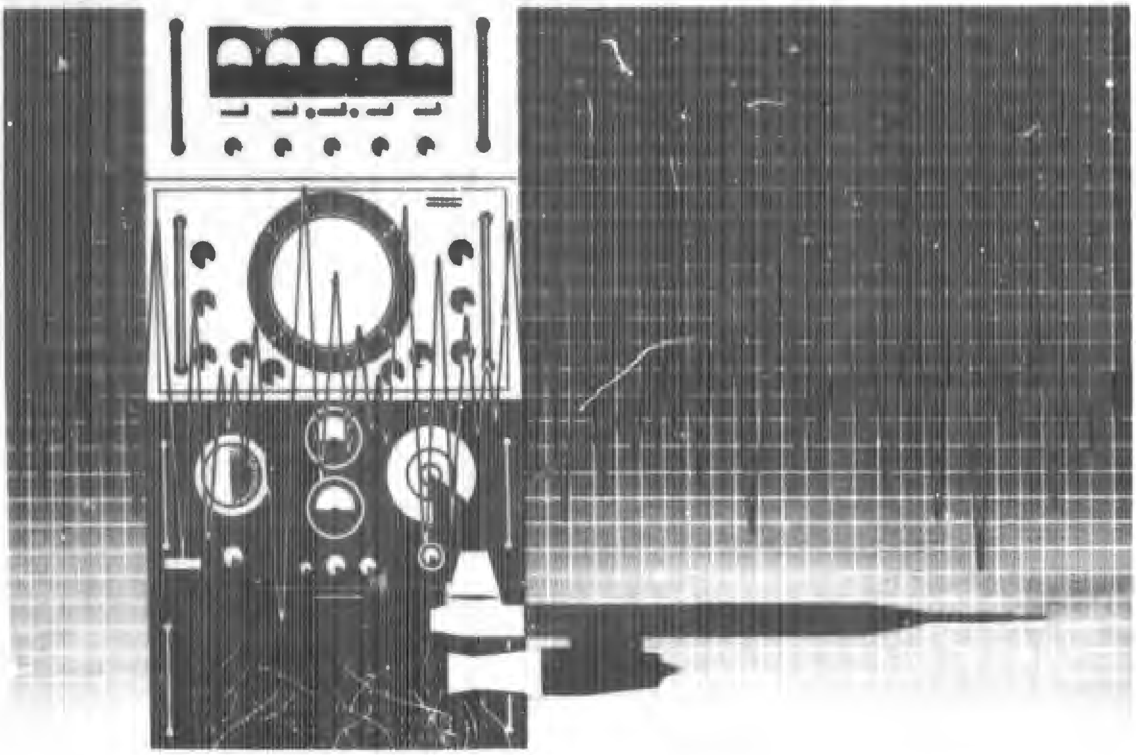
The parachute subsystem is composed of a drag parachute and a main parachute with pilot chutes, a deployment bag and attach fittings for each.

During recovery at altitudes above 18,500 ft., drag chute deployment may be withheld pending guidance of the drone to a selected landing area.

The parachutes and recovery spike are derived from the recovery system used on the X-7A Ramjet Test Vehicle.

RECOVERY DEVELOPMENT PROGRAM PLAN





Telemetry

The telemeter unit obtains information from instruments in the airborne drone and transmits this and the firing error indicator miss-distance data to a ground receiving station.

The system transmits both pulse width modulated and subcarrier frequency modulated data. The PWM subsystem samples data quantities at 20/sec. and generates pulses with widths proportional to their values. The FM/FM subsystem receives continuous signals of quantities that vary too rapidly to be sampled and varies the frequency of a subcarrier oscillator for each signal.

The outputs of the PWM and FM subsystems are combined and fed to an FM transmitting system which radiates r-f energy to the ground receiving station.

Portions of the telemetry used in the drone are derived from the systems used in the X-7A Ramjet Test Vehicle and the X-7B Guidance Test Vehicle.

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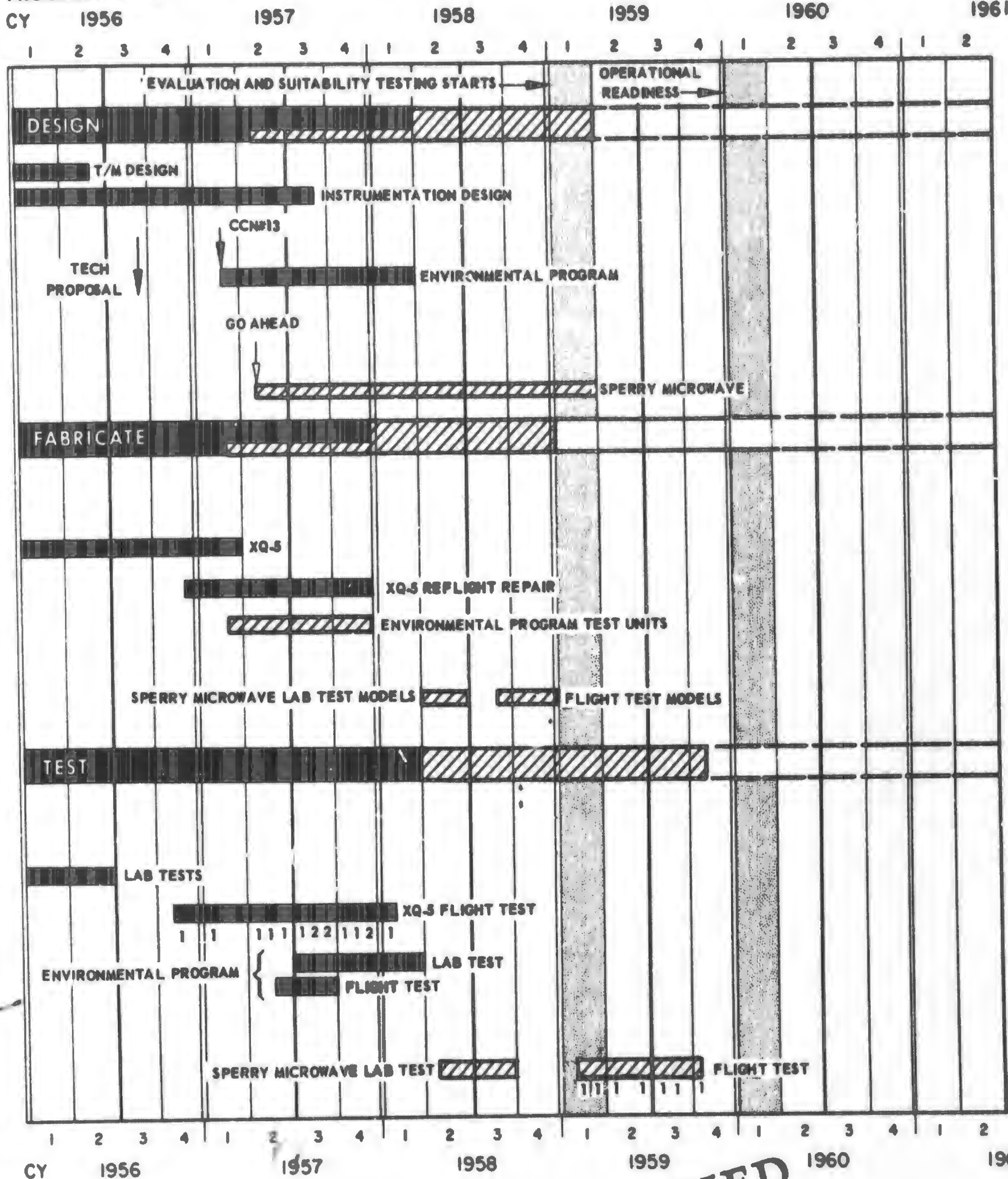
TELEMETRY DEVELOPMENT PROGRAM PLAN



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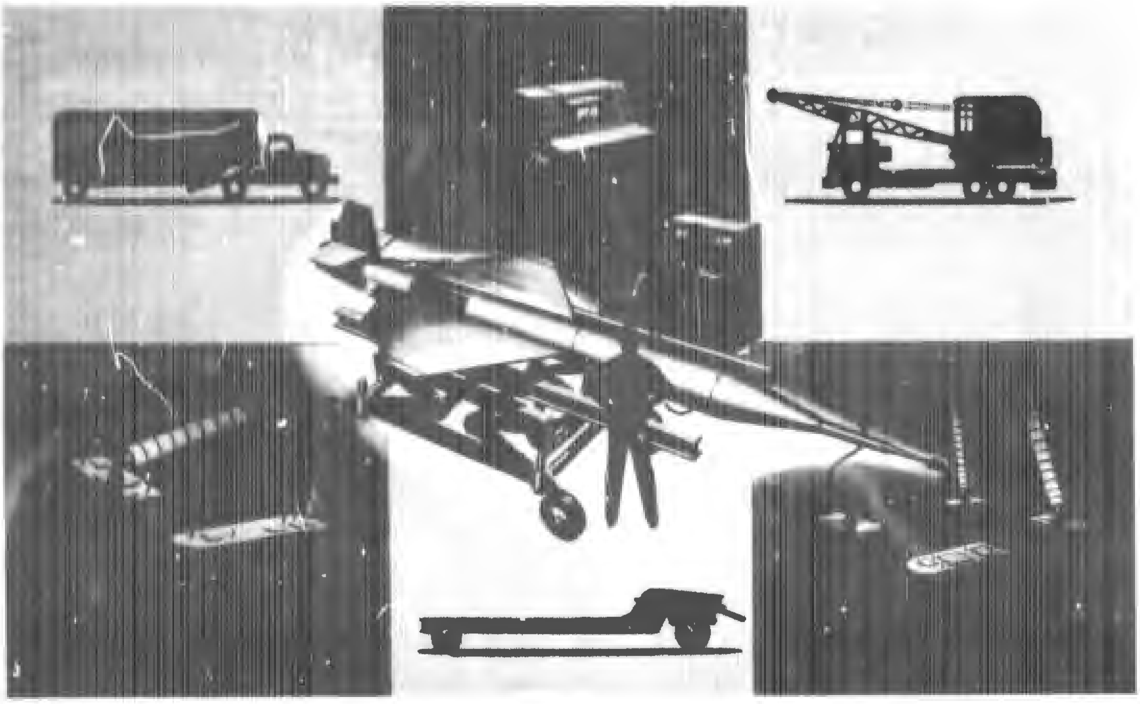

GROUND SUPPORT EQUIPMENT

Based on past experience in planning for, and the operation of, the X-7A Ramjet Test Vehicle and the X-7B Guidance Test Vehicle and an analysis of the special needs of the Q-5 program the following equipment is required:

DRONE HANDLING EQUIPMENT

DOLLY, TRANSPORT AND ASSEMBLY
DOLLY, SUBASSEMBLY TRANSPORT AND ASSEMBLY
CRADLE AND ACCESSORIES, NOSE CONE
CRADLE AND ACCESSORIES, EQUIPMENT BEAM ASSEMBLY
CRADLE AND ACCESSORIES, AFTER FUSELAGE ASSEMBLY
CRADLE AND ACCESSORIES, WING ASSEMBLY
CRADLE AND ACCESSORIES, RAMJET ENGINE
CRADLE AND ACCESSORIES, MIDFUSELAGE ASSEMBLY
STANDS, STRUCTURES STORAGE AND INSTALLATION
DOLLY, BOOSTER TRANSPORT AND INSTALLATION
CG LOCATOR
RECOVERY BEAM, FORWARD
RECOVERY BEAM, AFTER
SLING, MIDFUSELAGE
SLING, WING
SLING, BOOSTER
SLING, RAMJET ENGINE
SLING, RECOVERY, HELICOPTER/BOAT
COVER, RAMJET ENGINE
COVER, NOSE SPIKE
COVERS, WING
COVER, EMPENNAGE
LOADING PIT
HANDBOOKS AND LOGBOOKS
PACKAGING

DRONE SERVICING EQUIPMENT

CONSOLE, SYSTEM CHECK
CONSOLE, LOMB-1 SUBSYSTEM CHECKOUT
CONSOLE, LORC-1A SUBSYSTEM CHECKOUT
CONSOLE, AUTOPILOT SUBSYSTEM CHECKOUT
CONSOLE, FEI SUBSYSTEM CHECKOUT
CONSOLE, TELEMETERING SUBSYSTEM CHECKOUT
CONSOLE, ELECTRICAL SUBSYSTEM CHECKOUT
GROUND COOLING EQUIPMENT
TURBOALTERNATOR CHECKOUT EQUIPMENT
FUSELAGE LEAKAGE TESTER
PARACHUTE PACKING EQUIPMENT
LAUNCH AIRCRAFT CHECKOUT BOX
HANDBOOKS AND LOGBOOKS
SPARES, GROUND SUPPORT EQUIPMENT
ALIGNMENT TOOLS

OPERATIONAL EQUIPMENT

CONTROL DISPLAY STATION
TELEMETERING/FIRING ERROR INDICATOR GROUND STATION
TRANSLAUNCHER AND TRACTOR
TRANSLAUNCHER CHECKOUT BOX
HANDBOOKS AND LOGBOOKS

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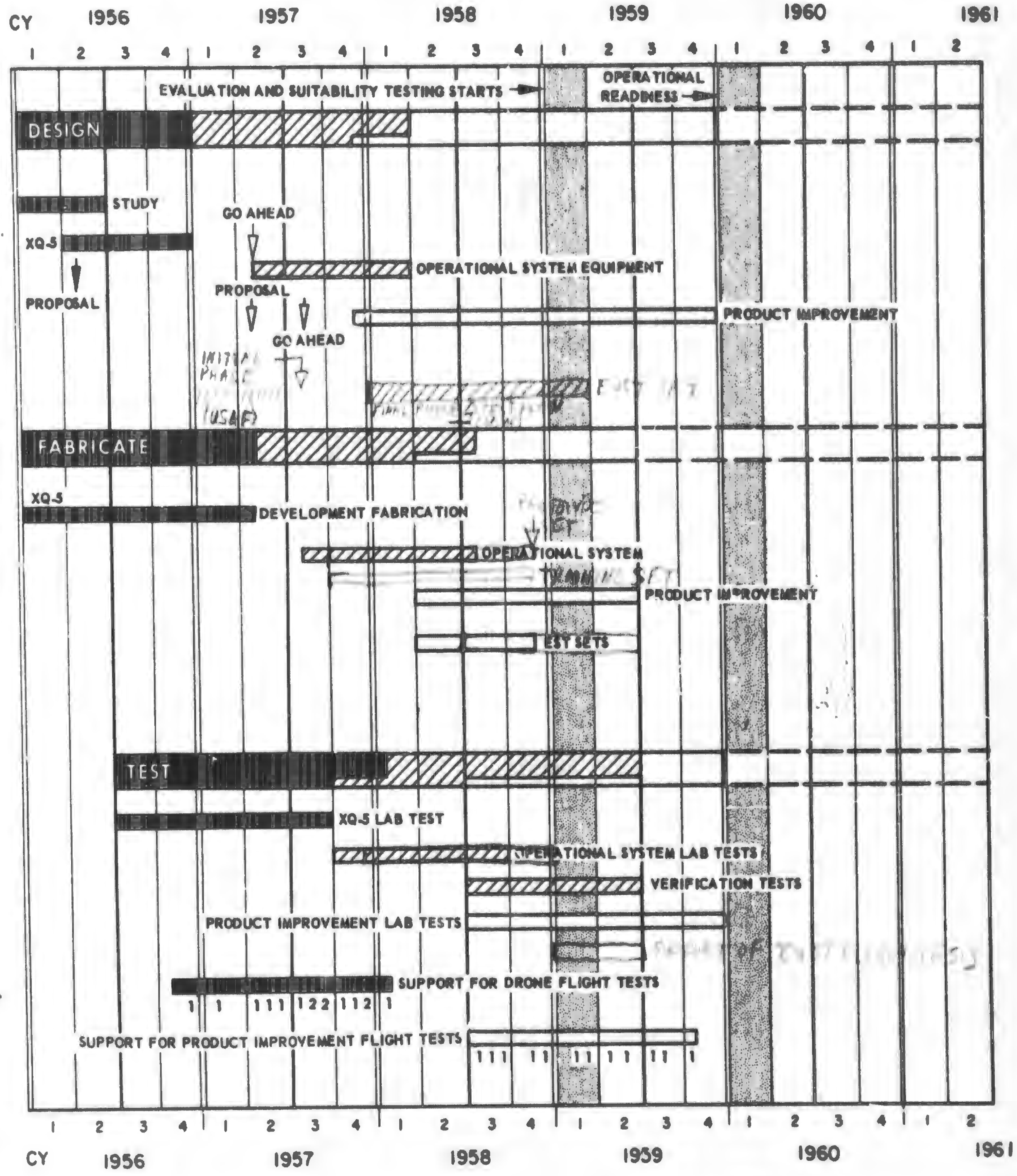
GROUND SUPPORT EQUIPMENT DEVELOPMENT PROGRAM PLAN



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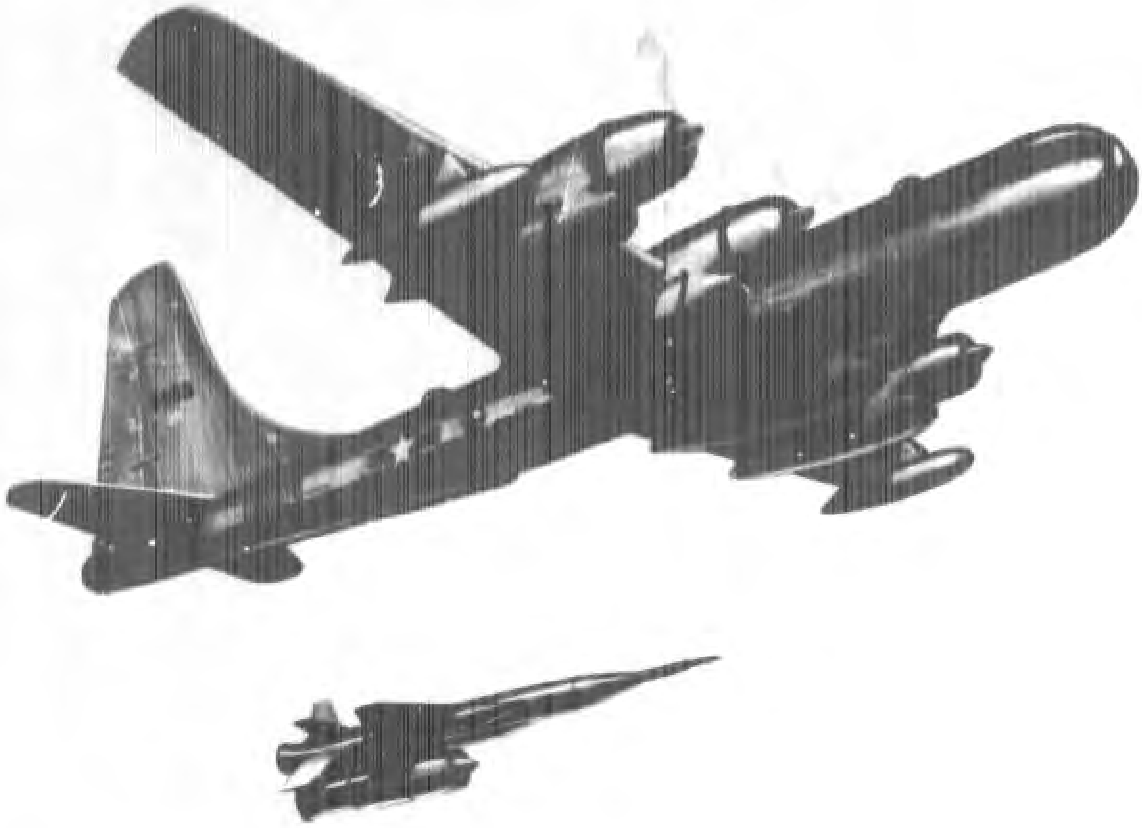
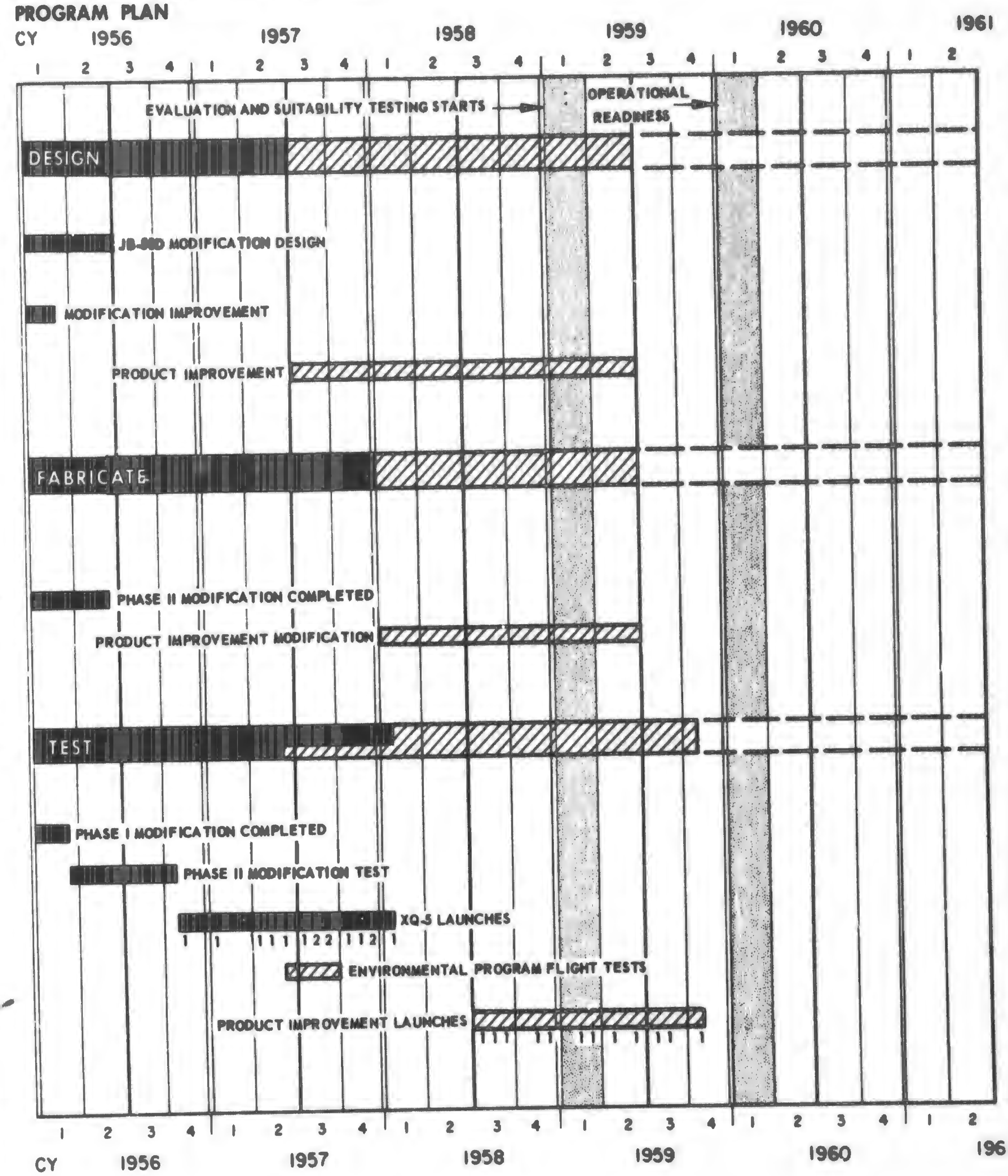
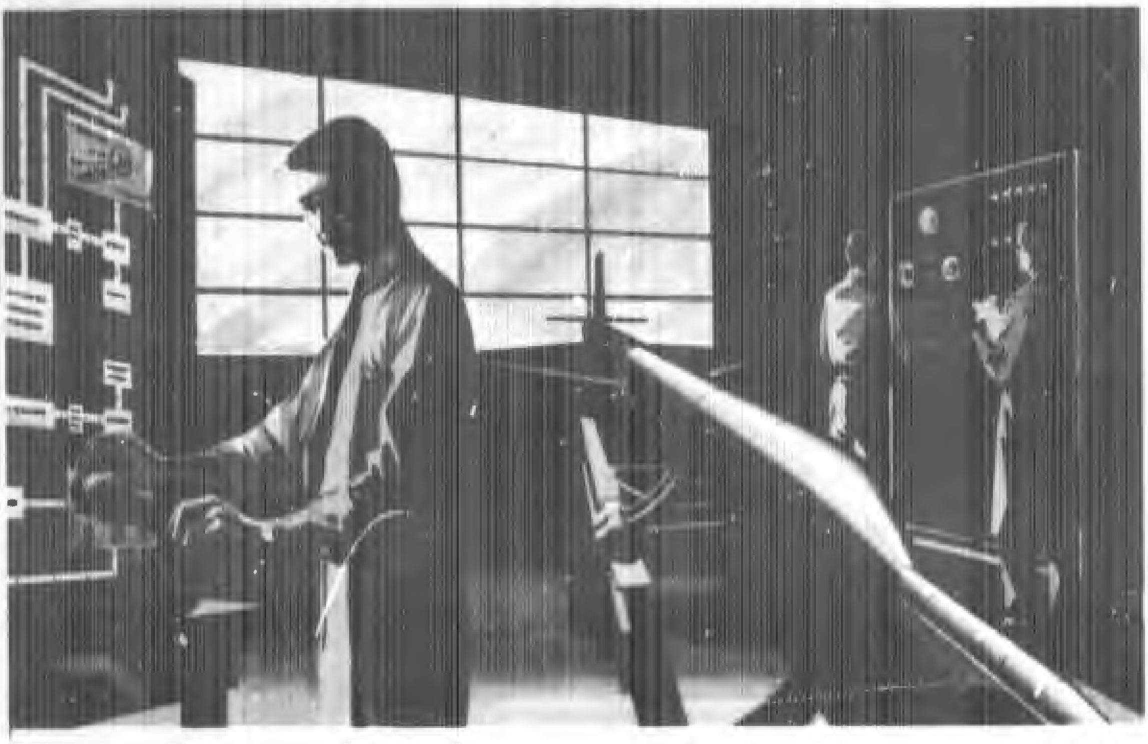


AIR SUPPORT EQUIPMENT

In conjunction with the development of air-launch provisions for the Lockheed X-7A Ramjet Test Vehicle and the X-7B Guidance Test Vehicle, a JB-50D Aircraft, Serial No. 48-068, was bailed to Lockheed MSD by the Air Force in November 1954. This aircraft has been modified to provide drone checkout, air launch, and photo documentation. A launch platform is installed in the forward end of the after bomb bay and a system of sway braces is used to steady the captive drone. The bomb bay doors were modified. A control console, installed between the pilot and copilot instrument panels, checks and monitors the drone prior to launch. An automatic photo observer panel will record launch aircraft instrumentation before, during and after launch.

AIR SUPPORT EQUIPMENT DEVELOPMENT PROGRAM PLAN





TRAINING EQUIPMENT

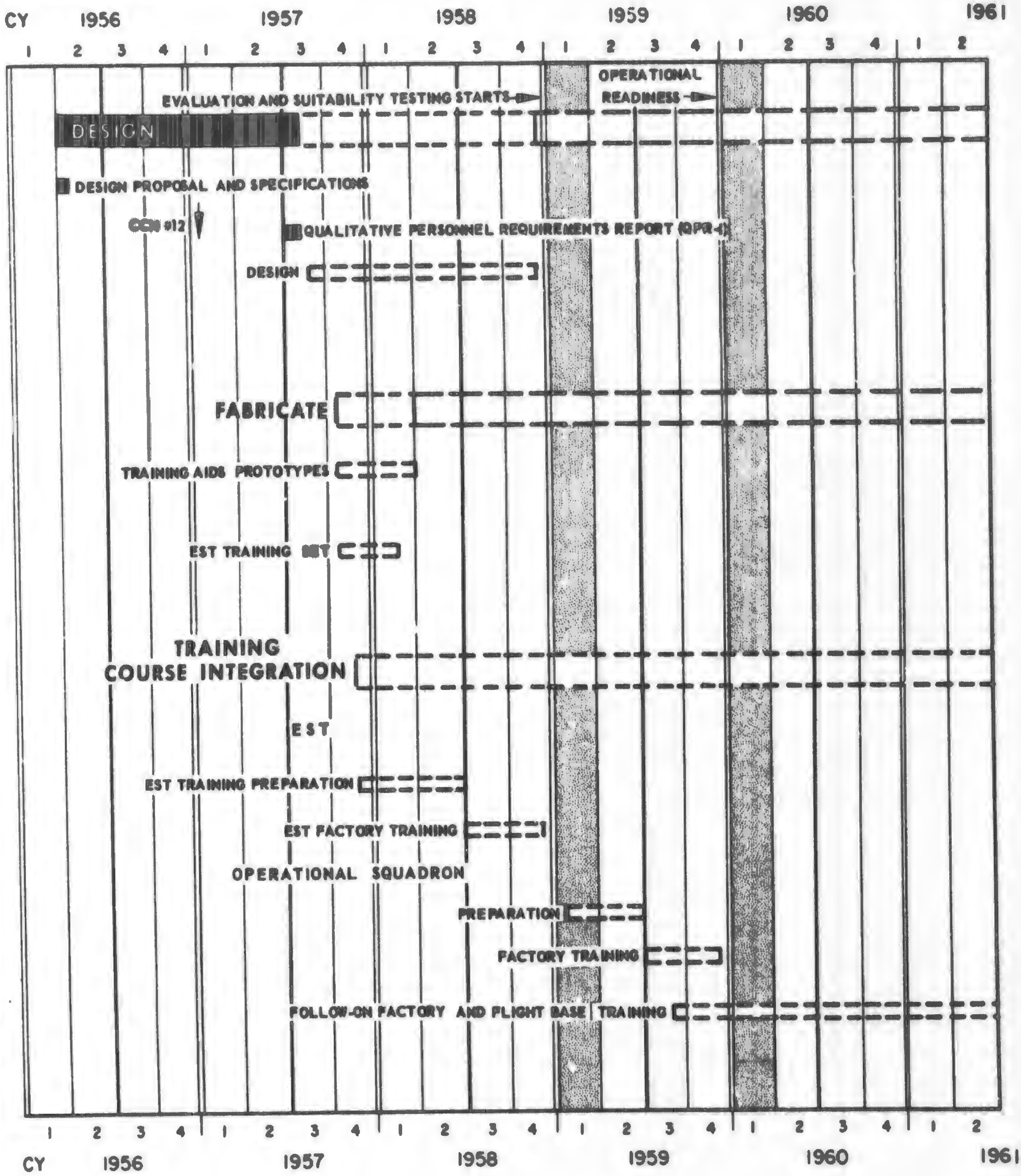
Detailed planning for training equipment based on a tentative training program has been submitted in Lockheed Report No. MSD-1621, "Q-5 High Supersonic Drone System Training Aids Proposal". The tentative training program was submitted in Lockheed Report No. MSD-1619, "Q-5 High Supersonic Drone System Training Program Proposal".

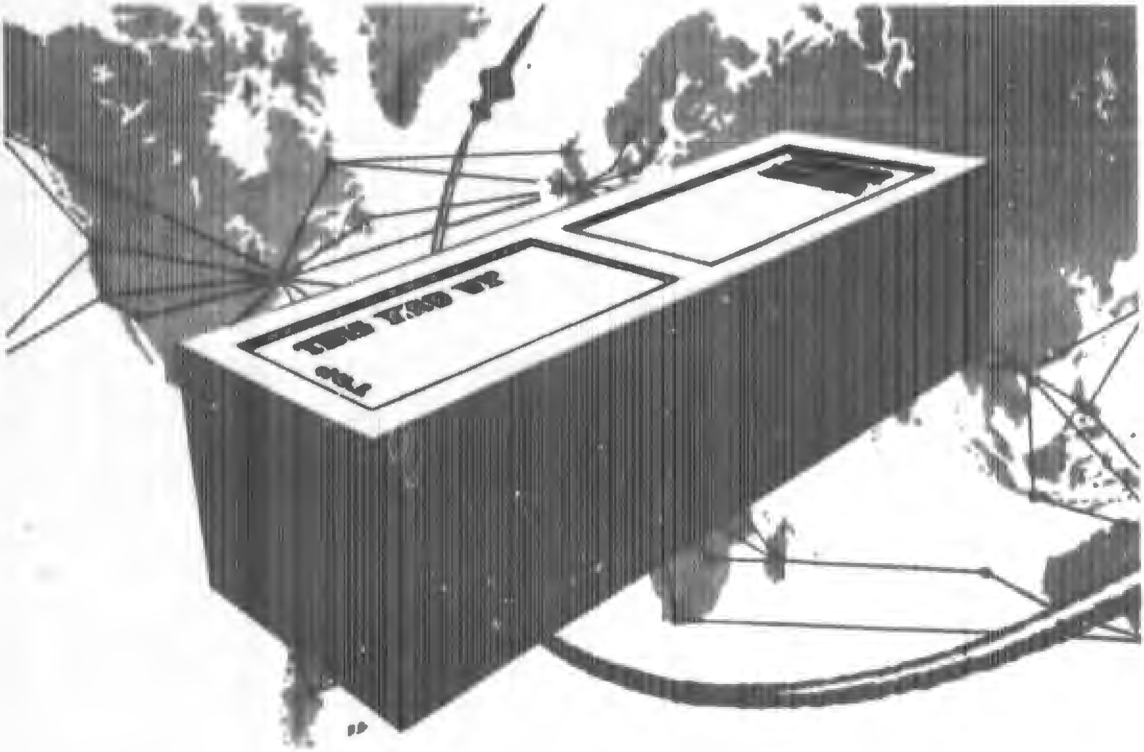
It has been concluded that an in-factory course with some flight-base follow-up training will fulfill the manpower training requirements for both EST and initial operations.

The training equipment considered essential to the EST program consists of the following CFE:

- Back-illuminated Trainer Panels including a Flight Profile Panel
- Transparencies
- Motion Pictures
- Wall Charts
- Student Texts
- Instructor Guides

TRAINING EQUIPMENT DEVELOPMENT PROGRAM PLAN





PACKAGING

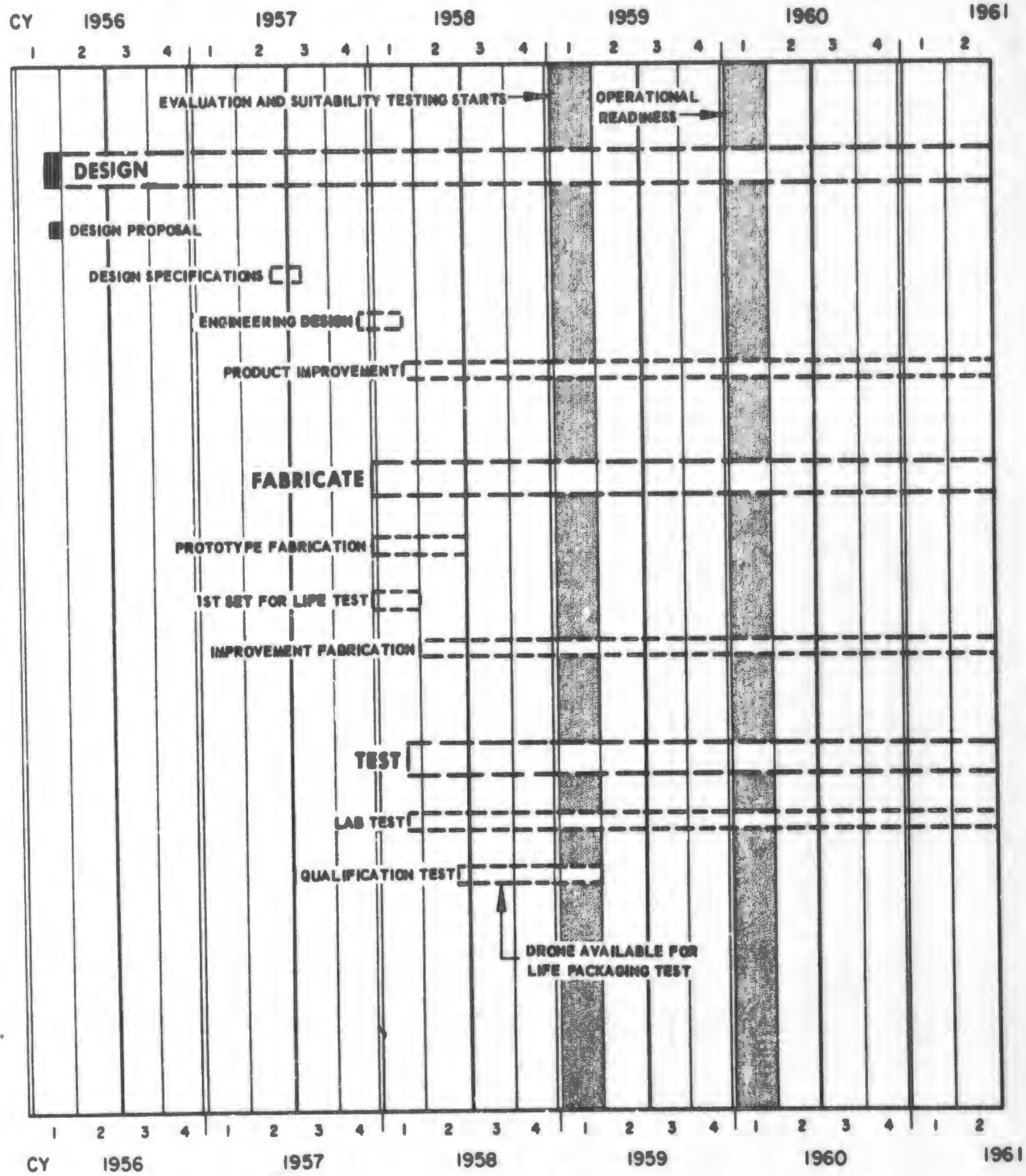
Factors considered in determining the division of the components of the drone system for packaging include the following:

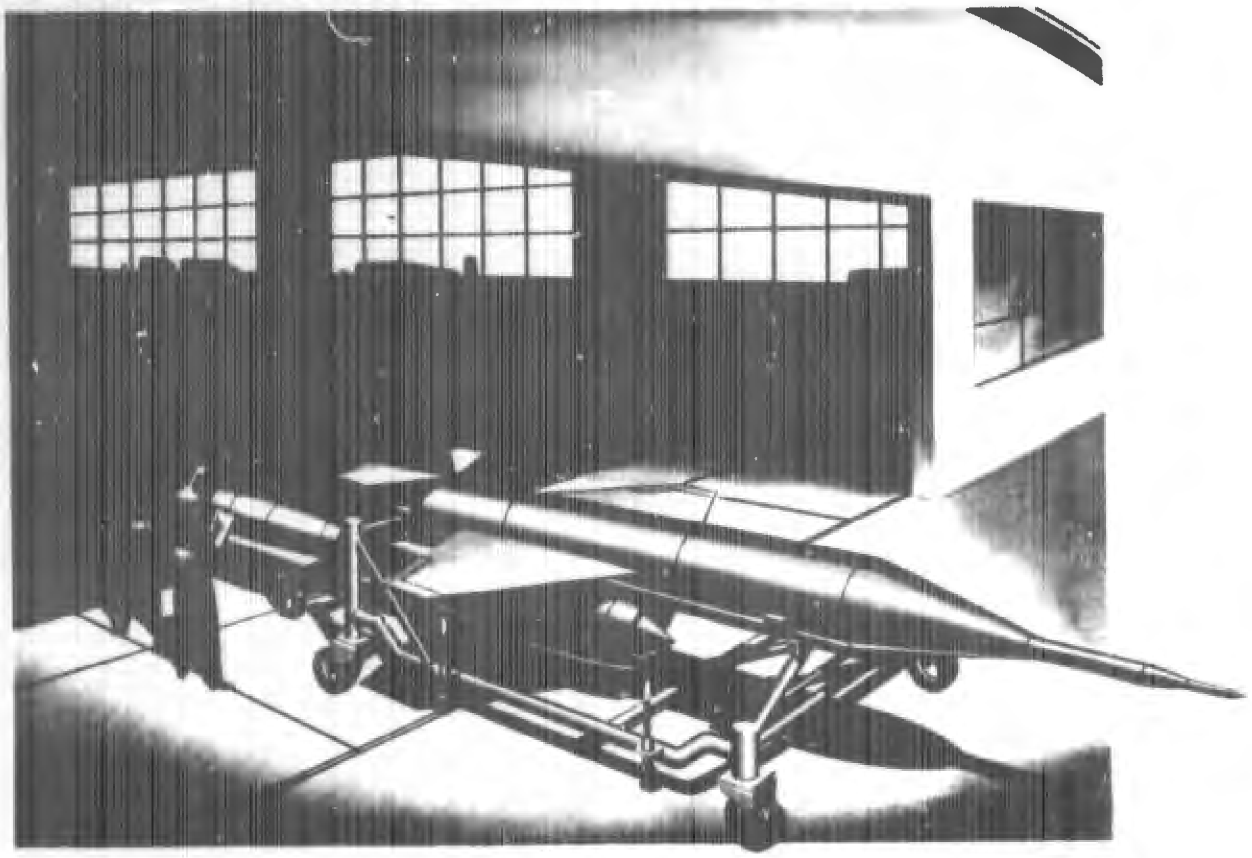
- Minimum amount of weapon disassembly.
- Minimum number of packages.
- Practicable methods of separation of each complete article.
- Package performance requirements.
- Availability of materials.
- Minimum investment in article reassembly.
- Transportation limitations.
- Optimum weight, size, cost and cube.
- Compatibility of preservation requirements for the contents of a single container.
- Compatibility of shipping and storage requirements with special emphasis on dangerous and corrosive components.
- Availability of standard reusable containers.
- The possibility of transporting wholly or partly assembled drones secured in the launching mechanism of the launch aircraft.

A breakdown of the packaging requirements is contained in Table V of Lockheed Report No. MSD-1629, "YQ-5 Drone Packaging Design Proposal."

In the event it is decided to transport wholly or partly assembled drones secured in the launching mechanism of the launch aircraft, the packaging program presented will require modification.

LOGISTIC PACKAGING DEVELOPMENT
PROGRAM PLAN

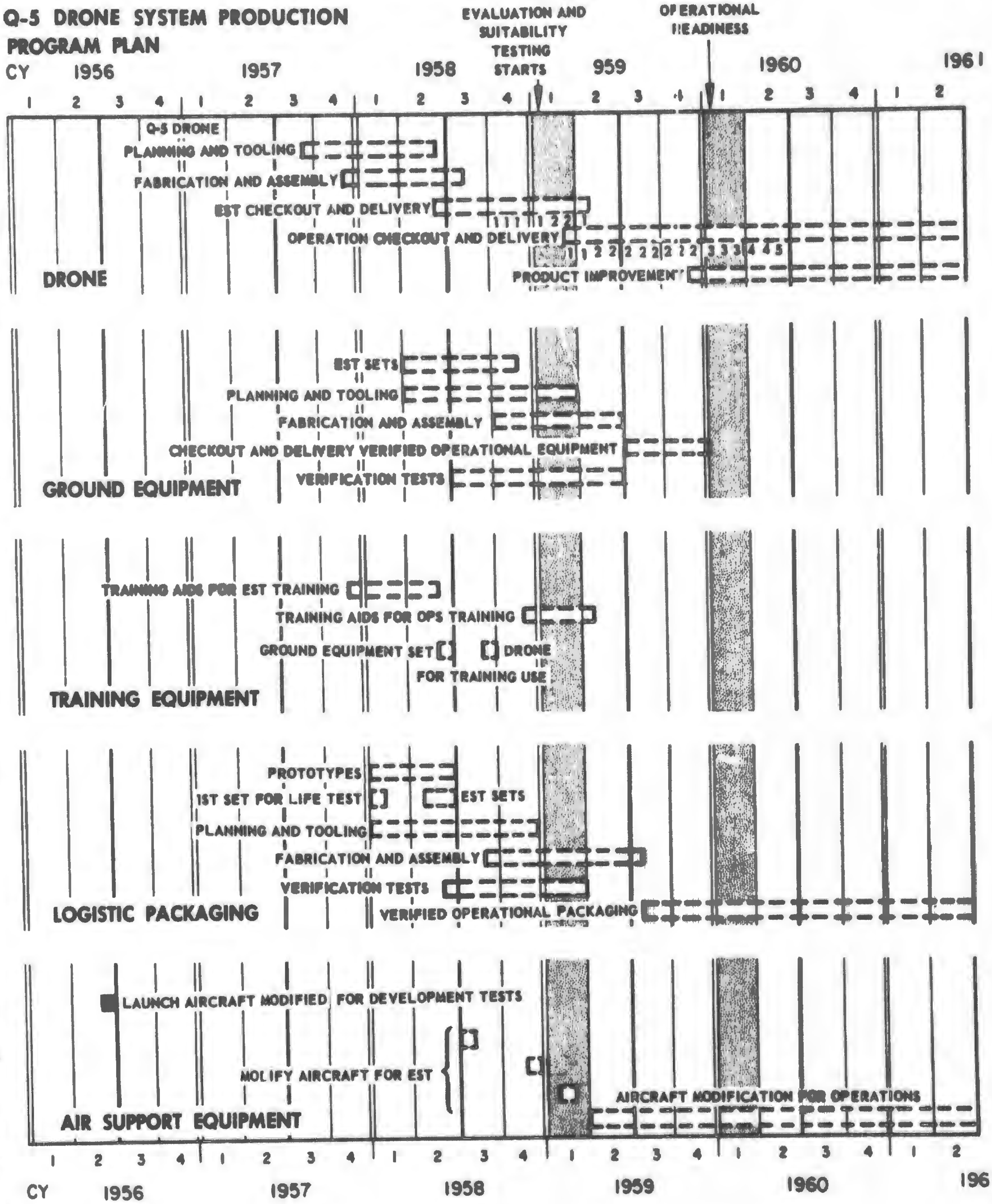


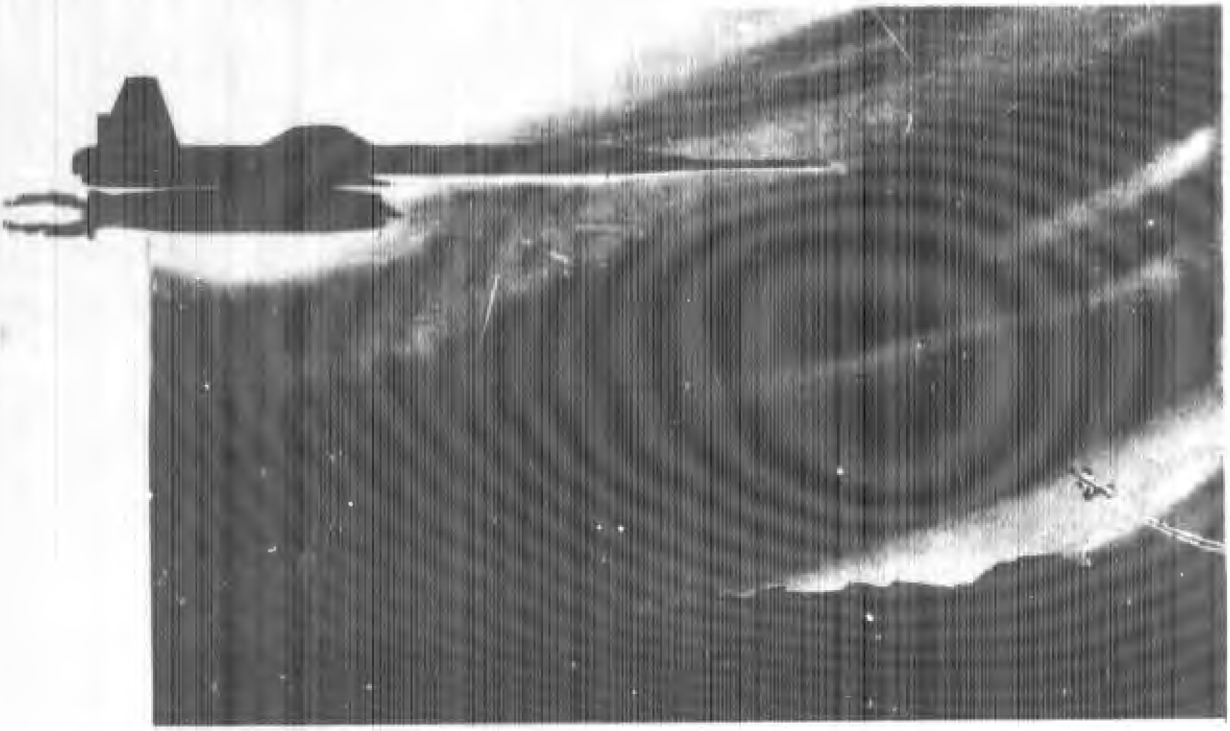


PRODUCTION

The manufacturing plan is based on the production of a tentative standard drone following successful completion of the development program plan. Preliminary design for tooling, production facilities, manpower and material must closely follow completion of component development in order to meet the requirements for operational readiness. This will be substantially aided by the producibility study program which is designed to insure that component design efforts are properly guided toward available manufacturing tools, techniques and material essential to early production.

Manufacturing plant space, personnel and equipment requirements for reaching a production rate build-up to eight drone systems per month are programmed. Continuing careful attention to manufacturing requirements must be maintained in the course of the development program with subsequent provisions for incorporating benefits obtained from product improvement efforts.


Q-5 DRONE SYSTEM PRODUCTION PROGRAM PLAN
EVALUATION AND SUITABILITY TESTING STARTS
OPERATIONAL READINESS
CY 1956 1957 1958 1959 1960 1961
Q-5 DRONE
PLANNING AND TOOLING
FABRICATION AND ASSEMBLY
EST CHECKOUT AND DELIVERY
OPERATION CHECKOUT AND DELIVERY
PRODUCT IMPROVEMENT
DRONE
EST SETS
PLANNING AND TOOLING
FABRICATION AND ASSEMBLY
CHECKOUT AND DELIVERY VERIFIED OPERATIONAL EQUIPMENT
VERIFICATION TESTS
GROUND EQUIPMENT
TRAINING AIDS FOR EST TRAINING
TRAINING AIDS FOR OPS TRAINING
GROUND EQUIPMENT SET
DRONE FOR TRAINING USE
TRAINING EQUIPMENT
PROTOTYPES
1ST SET FOR LIFE TEST
EST SETS
PLANNING AND TOOLING
FABRICATION AND ASSEMBLY
VERIFICATION TESTS
VERIFIED OPERATIONAL PACKAGING
LOGISTIC PACKAGING
LAUNCH AIRCRAFT MODIFIED FOR DEVELOPMENT TESTS
MODIFY AIRCRAFT FOR EST
AIRCRAFT MODIFICATION FOR OPERATIONS
AIR SUPPORT EQUIPMENT



OPERATIONS

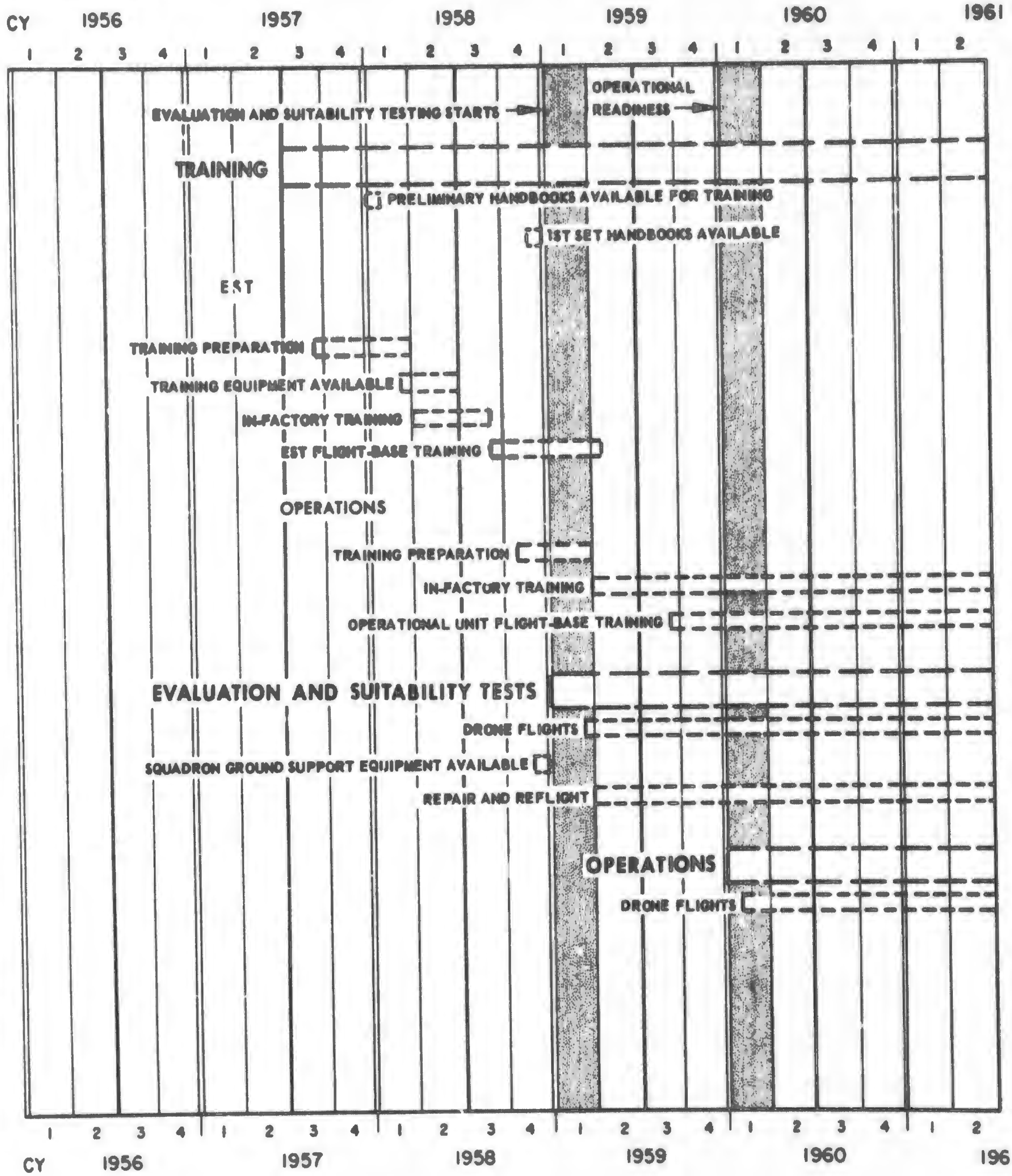
Operational planning considerations are categorized into training, evaluation and suitability testing (EST), and tactical operations. Planning in this area is limited by the absence of a formal operational plan. The resulting tentative plans are based on an assumed date for the beginning of the evaluation and suitability test program in the first quarter, 1959 and an operational readiness date one year later.

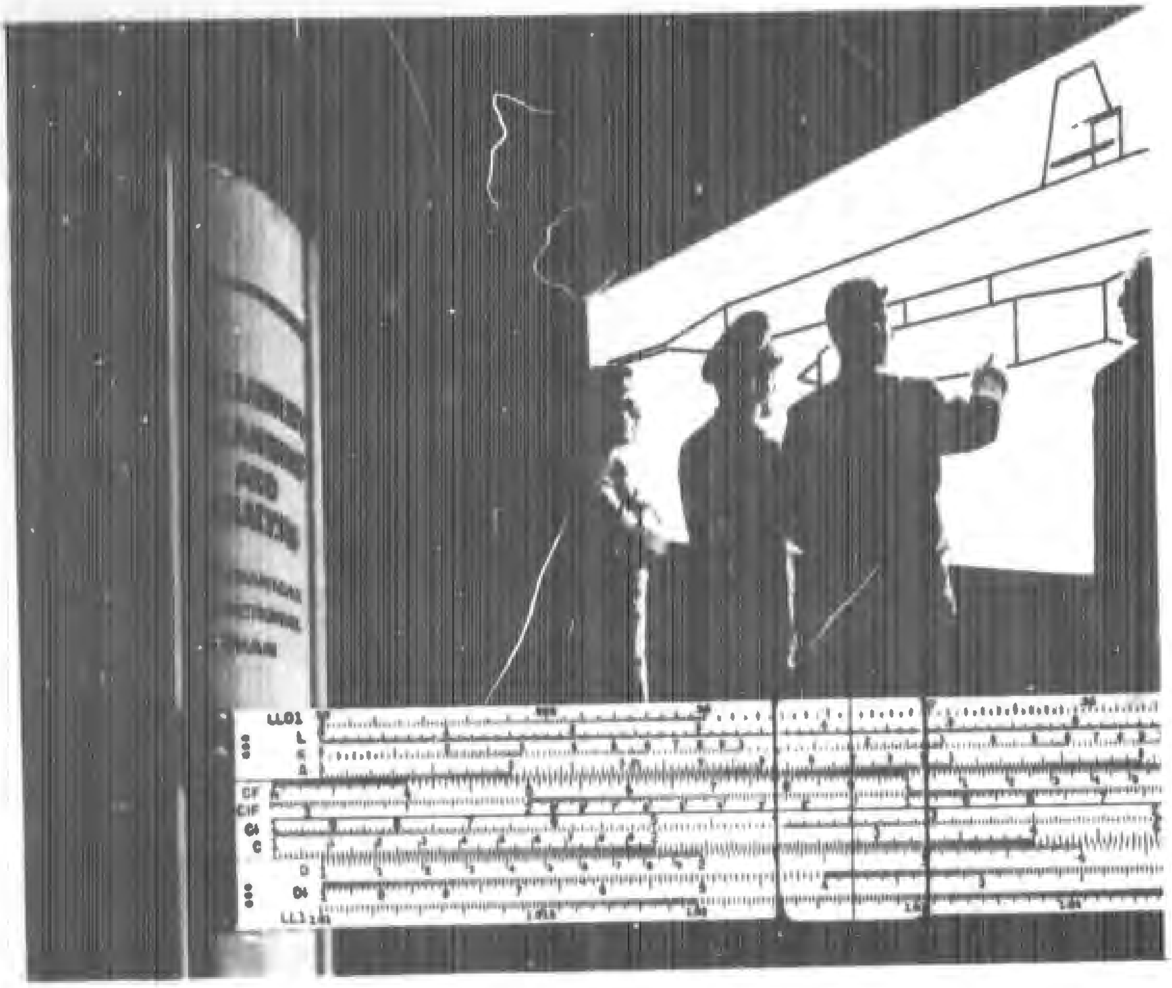
Training can be conducted for both the EST and operational phases in a factory training program followed by a short flight-base follow-up course in which actual launching operations would be performed. Training programs are scheduled for minimum lead time to prepare for EST in order to utilize the latest equipment designs evolving from the development program.

The EST program is planned for a one year period at the earliest possible point in the drone system's development where a suitable drone will be available. Thirty drone flights are programmed for the EST operation.

The operational phase is assumed to commence from the operational readiness date, first quarter, 1960, utilizing the majority of military personnel who have had training and operational experience in the EST program. Supplementing the EST organization with additional trained personnel will provide an immediate operational capability of launching four drones per week.

SYSTEM OPERATIONS
PROGRAM PLAN





SYSTEM STUDIES

The concurrent system study program is for the purpose of establishing an operationally suitable Q-5 Drone System in the minimum time and with minimum cost. Reliability, producibility and operations are its principal subjects. A continuous review of all developmental experience will be fed back into the system study for analysis, evaluation and application.

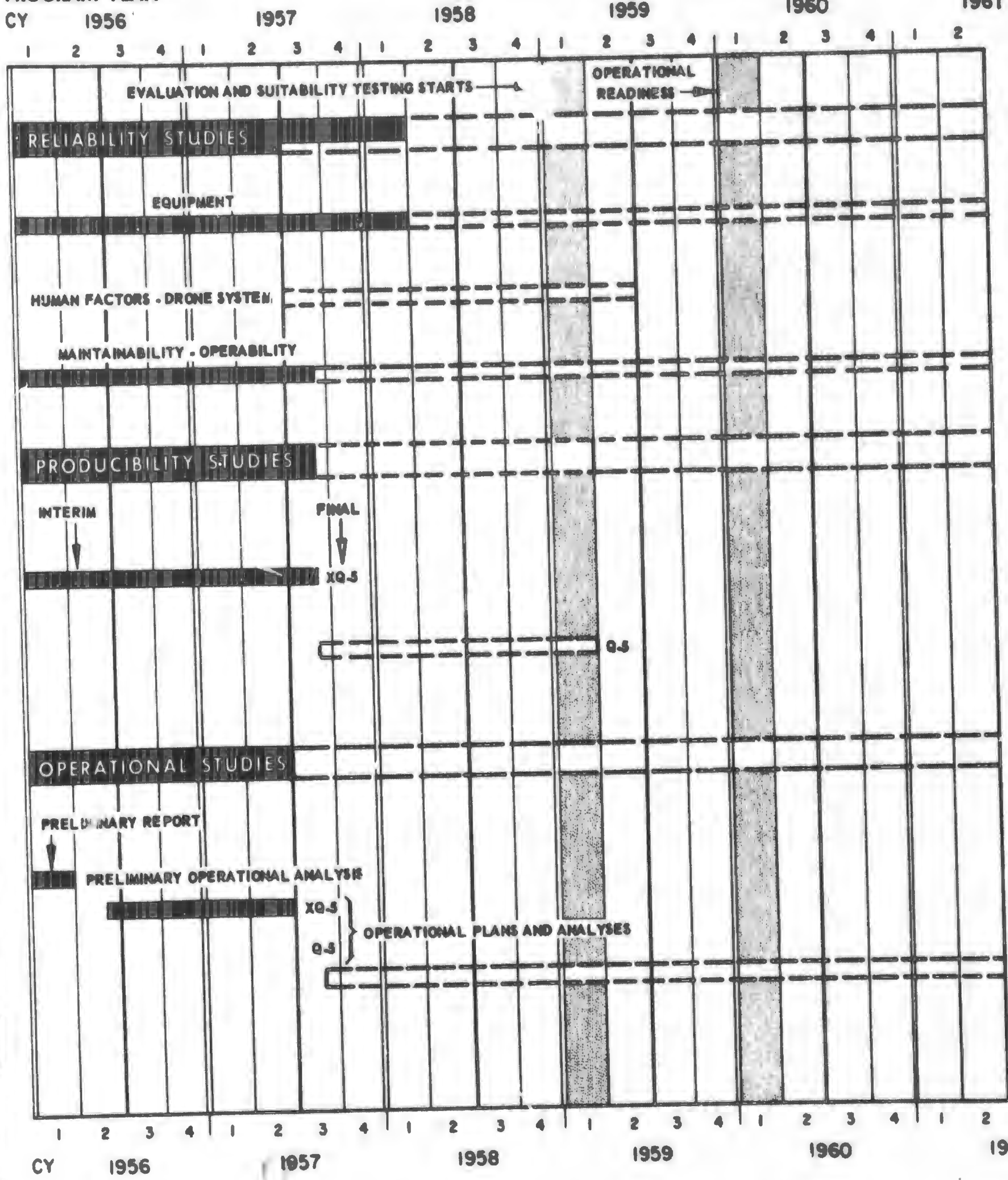
The study for reliability includes the establishment of a high level of dependability of the components and the system. Maintainability, a funciton of reliability, will be studied toward establishing design criteria to produce a system that is easily maintained and quickly serviced.

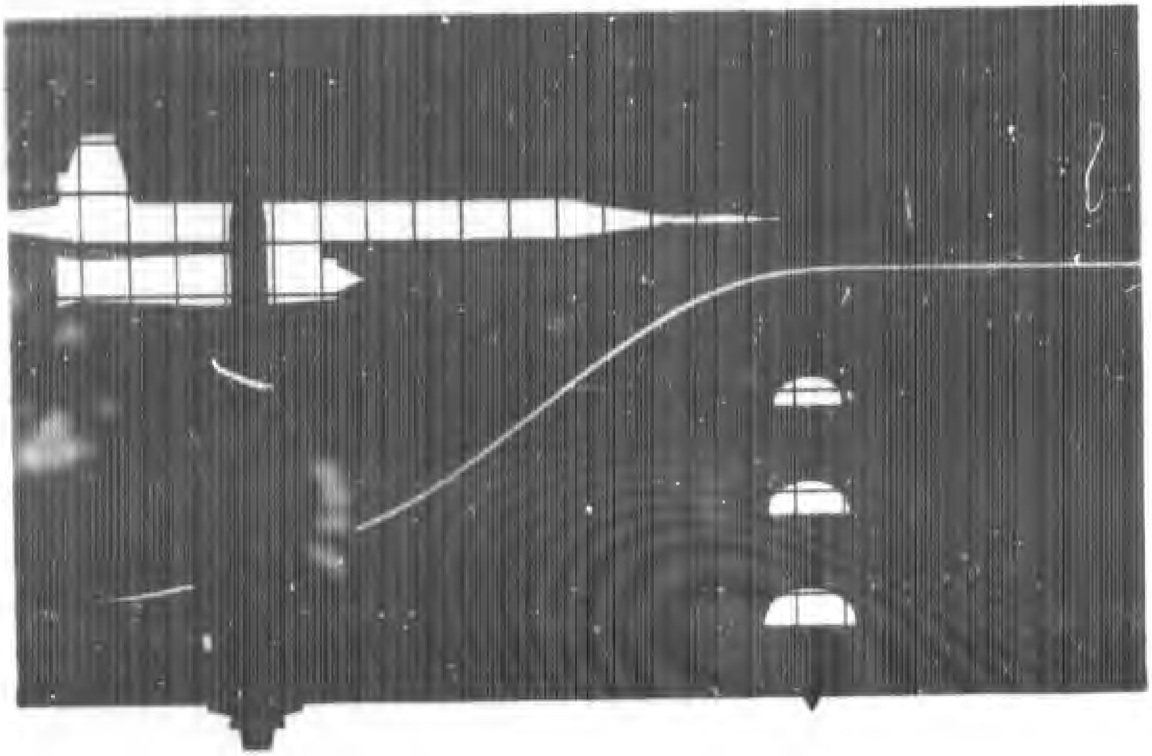
The study for producibility is to establish design criteria that will provide a drone system in the least time and at the lowest cost consistent with reliability.

Operational studies will be aimed at establishing design criteria to provide the greatest facility of use of the drone system in its operating environment.

Human engineering studies will play a large part in all of the system studies.

SYSTEM STUDIES
PROGRAM PLAN



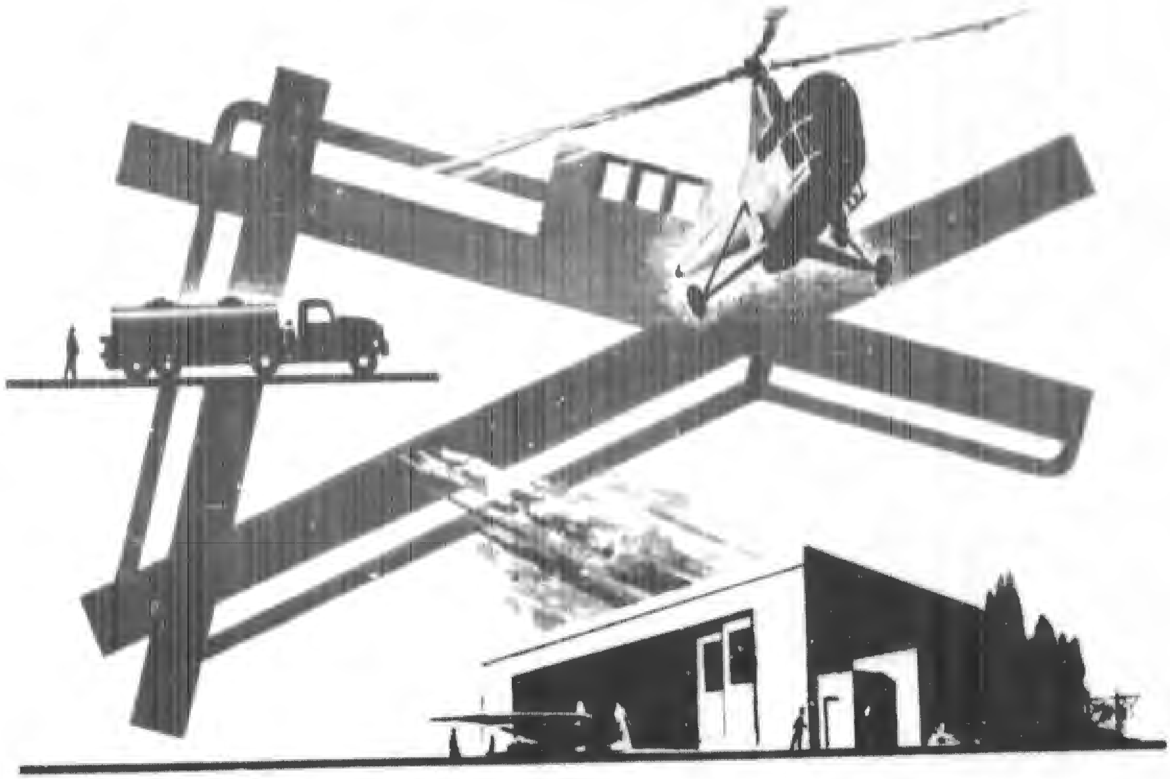


SYSTEM PLANNING DATA SUMMARY

This section includes the requirements for facilities for the XQ-5 Drone, a schedule of government furnished property, a schedule of technical data to be supplied by Lockheed MSD to the Air Force, and a breakdown of funding and man-hours.

Funding and manhours are presented in curves that compare cost and man-hours vs. time for the XQ-5 Research and Development time period. The projected rate of expenditure of funds for the transition from an XQ-5 Drone development into Q-5 Drone System military operations is also presented.

The technical data comprises monthly fiscal progress reports; weekly activity letters; flight test plans, data reduction and test reports, quarterly progress reports; quarterly program planning reports; specifications and revisions thereto, and miscellaneous reports on the development of individual components and systems that are required by the contract.



FACILITIES

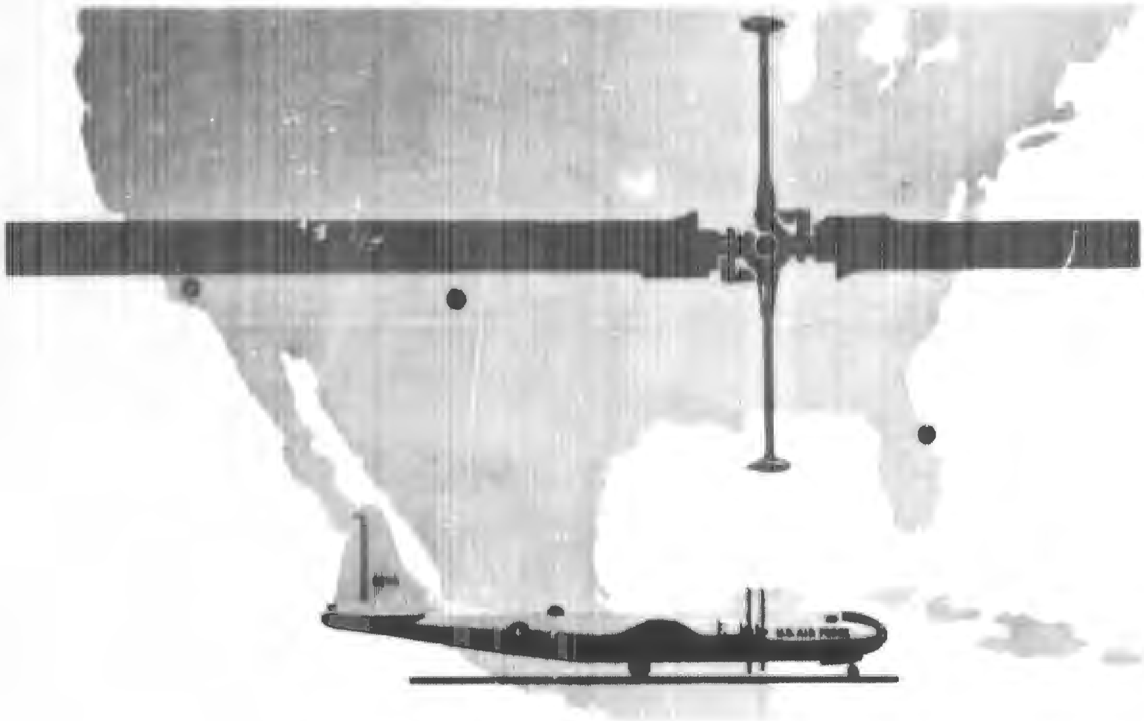
All initial ground testing and checkout will be performed at Lockheed Missile Systems Division at Van Nuys, California insofar as practicable. Actual flight tests and tests requiring ranges or conditions beyond the capabilities of LMSD will be performed at HADC, and NOTS.

Facilities at HADC will be required for all short-range flights. A comprehensive description of Lockheed XQ-5 Target program facility requirements is contained in Lockheed Report No. MSD-1026, "Test Facilities Required by Lockheed MSD at HADC."

XQ-5 Target No. 2 has undergone water entry and flotation tests at Morris Dam water test facility, at NOTS.

Loading pits will be required (one each at HADC and Lockheed MSD) to provide the required vertical clearance between the target and the bottom of the launch aircraft. Details of the loading pit design are contained in Lockheed Report No. 1612, "Detail Specification for the YQ-5 High Supersonic Drone Support Equipment, Design Proposal Issue".

The government furnished properties required at HADC are listed in detail in the GFP section. In addition, component and launch aircraft maintenance shelters, as well as shop, test equipment, assembly, explosives storage and refrigerant storage shelters will be required.



GOVERNMENT FURNISHED PROPERTY

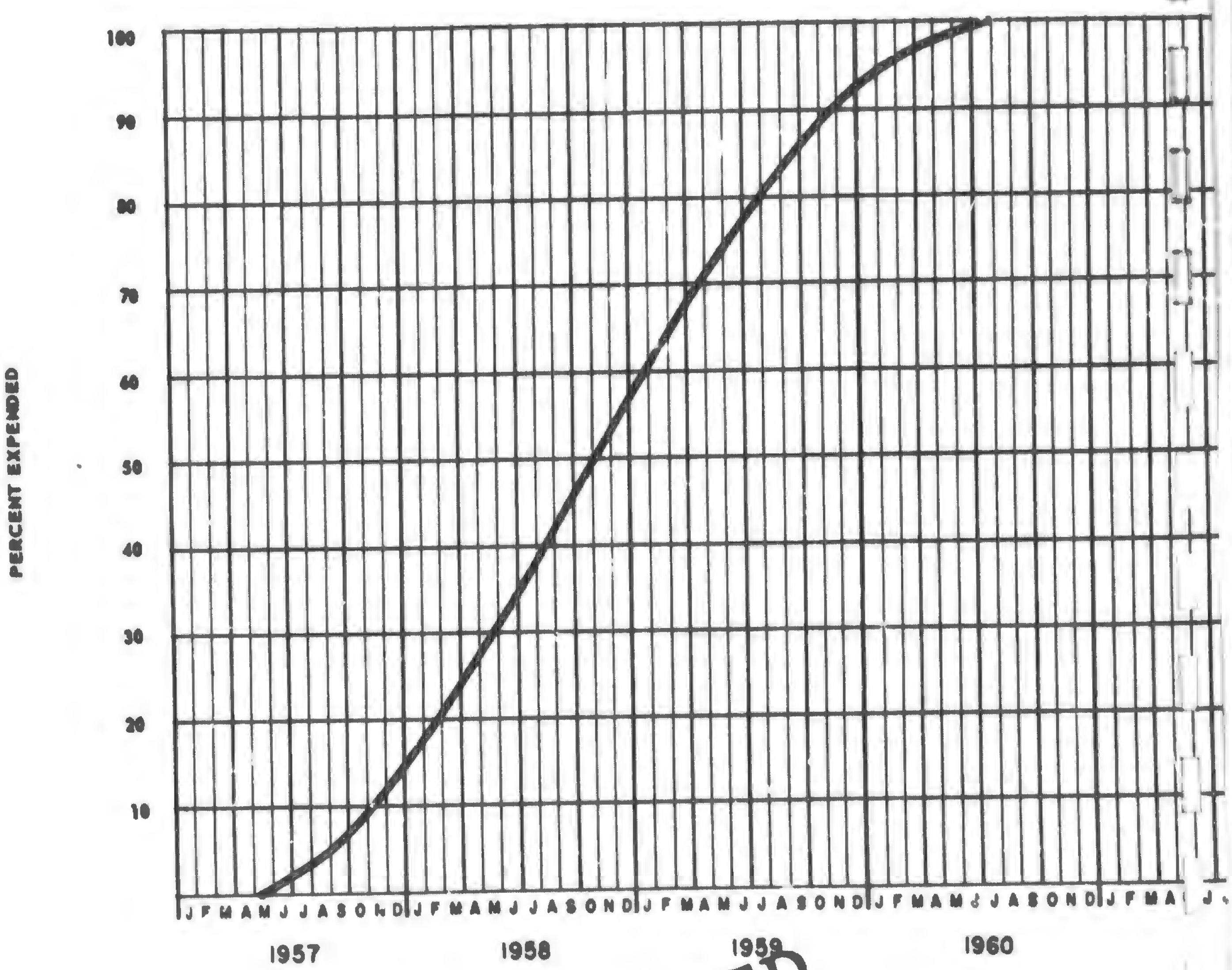
The requirements for GFAE in relation to the XQ-5 Research and Development Program are presented on the opposite page. The GFP required for operations and maintenance at test bases includes the following:

COMMAND GUIDANCE STATION, MSQ-1
GENERATOR AND TRAILER
ELECTRICAL POWER SUPPLIES
BATTERY CHARGING EQUIPMENT
TRAILER, NITROGEN SERVICING
COMPRESSOR, 3500 PSI, 15 CFM
CUTTING TORCH EQUIPMENT, MOBILE
CONTINUITY CHECKER, IGNITER
FUELING EQUIPMENT, SINGLE POINT
TRUCK, F-7 GASOLINE TANK
TRUCK, 1.5-TON STAKE AND PLATFORM
TRUCK, 5-TON TRACTOR
SEMI TRAILER, 40-FT. PLATFORM
TRUCK, 2-TON FORK LIFT
TRAILER, M172 FLAT BED
TRUCK, M123 TRACTOR
TRUCK, M246 PRIME MOVER
TRACTOR, EARTH MOVING
TRUCK, RADIO EQUIPPED JEEP
TRUCK, 3/4-TON CARGO
SHOP AND ASSEMBLY AREA
ORDNANCE STORAGE AREA
REFRIGERANT STORAGE EQUIPMENT
HELICOPTER, H21C, GROUND RECOVERY
HELICOPTER, H5, SEARCH
AIRCRAFT, HELICOPTER ESCORT
A AND E MAINTENANCE SHELTER
AIRCRAFT MAINTENANCE EQUIPMENT
TRUCKS, AIRCRAFT GASOLINE
ANEMOMETER
BOAT, RECOVERY, 85-FT.
COMMUNICATION EQUIPMENT
PAINT STRIPPING AND REPAINTING EQUIPMENT
SPARES, GROUND SUPPORT EQUIPMENT
HEATER, TRAILER MOUNTED
JO-BOLT INSTALLATION TOOLS
WELDING EQUIPMENT
RIVETING AND SHEET METAL TOOLS
BOOSTER IGNITER TOOLS
ETHYLENE-OXIDE SERVICE TOOLS

FUNDING AND MANHOURS

Complete data on funding and manhours are presented regularly in the Lockheed MSD Monthly Fiscal Letter Report. The graph on this page presents the projected rate of expenditure of funds for the transition from an XQ-5 Drone development into Q-5 Drone System military operations. The graphs on the opposite page present cost and manhours vs time for the period covered by the present XQ-5 Research and Development Program.

Q-5 PROGRAM (RATE OF EXPENDITURE)



Item	Total Contract Req'd	Bal Due	Schedule (1956 – 1957 – 1958)
ROCKET, 5-IN. HVAR 0-86-ES-5800X302A1	10	0	REQUIREMENTS COMPLETE
ROCKET, 2.2KS - 11,000	2	0	REQUIREMENTS COMPLETE
MARQUARDT RAMJET ENGINE, MA20C MODIFIED PER CCN #1	6	0	REQUIREMENTS COMPLETE (ONE DUMMY)
SWITCH ASSY, BAROMETRIC, MC273	30	30	30 DELINQUENT
M2 REEFING LINE CUTTER, 2-SEC. DELAY	50	14	12 — DELINQUENT: 2 2 2 2 2 2; 2
M2 REEFING LINE CUTTER, 4-SEC. DELAY	20	0	REQUIREMENTS COMPLETE
M2 REEFING LINE CUTTER, 6-SEC. DELAY	50	29	29 — DELINQUENT: 5 2 2 2 2 2 2 2 2 2 2 2 2
M2 REEFING LINE CUTTER, 8-SEC. DELAY	20	0	REQUIREMENTS COMPLETE
M2 REEFING LINE CUTTER, 10-SEC. DELAY	50	0	REQUIREMENTS COMPLETE
ROCKET, "DEACON", X220A1, AND 220A7 OR-A8	12	0	REQUIREMENTS COMPLETE
ROCKET, AEROMITE, 2.75 FFAR	24	17	17 DELINQUENT (2 OF 7 RECEIVED DESTROYED DUE TO OVERAGE)
ROCKET, 3DS-47,000, X201A4	8	6	6 DELINQUENT
* RECEIVER, DRW-3	4	0	REQUIREMENTS COMPLETE
* TONE FILTER (DETROLA NO. D-52446)	4	0	REQUIREMENTS COMPLETE

* PROPOSED

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1956 1957 1958

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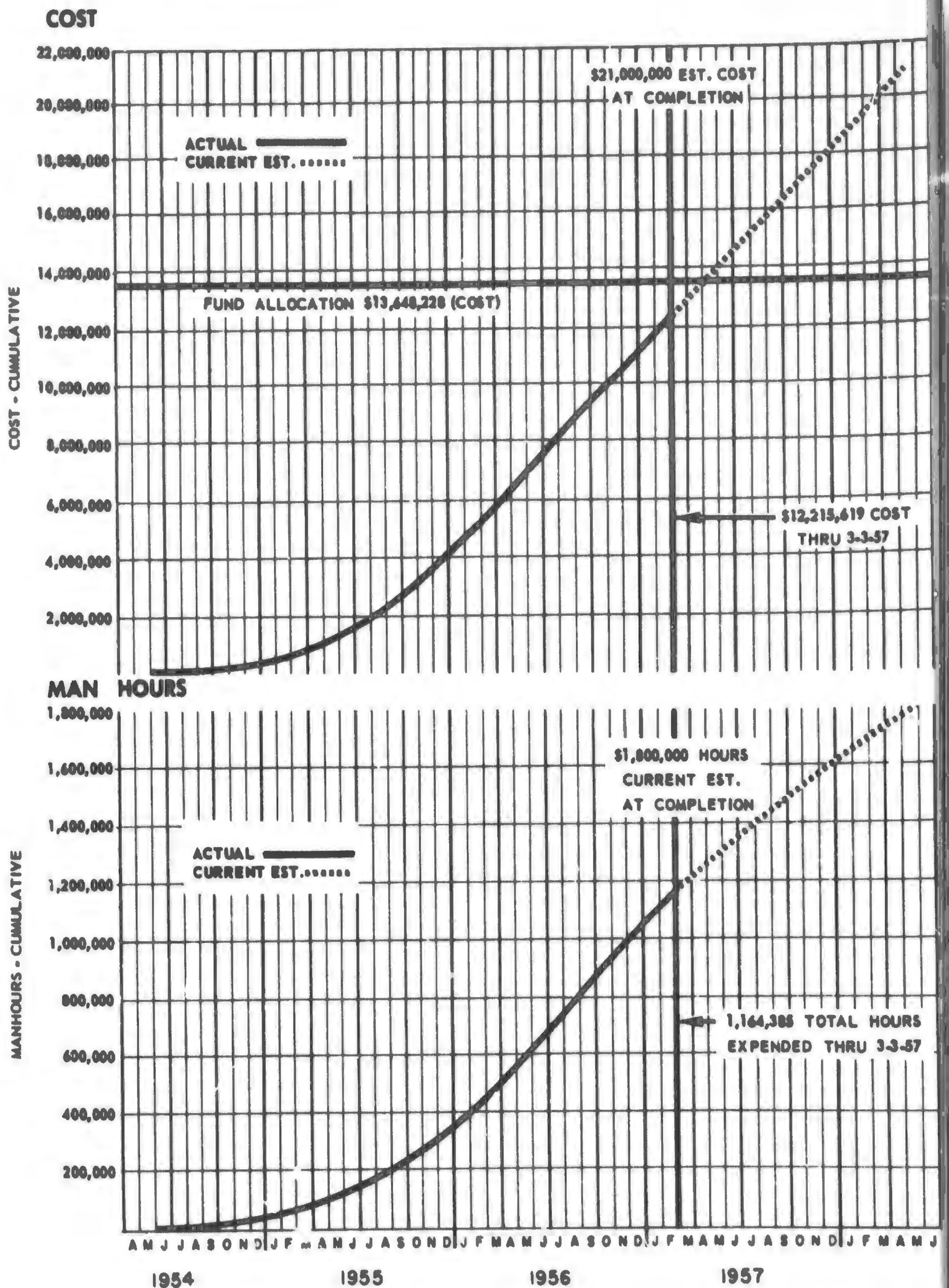

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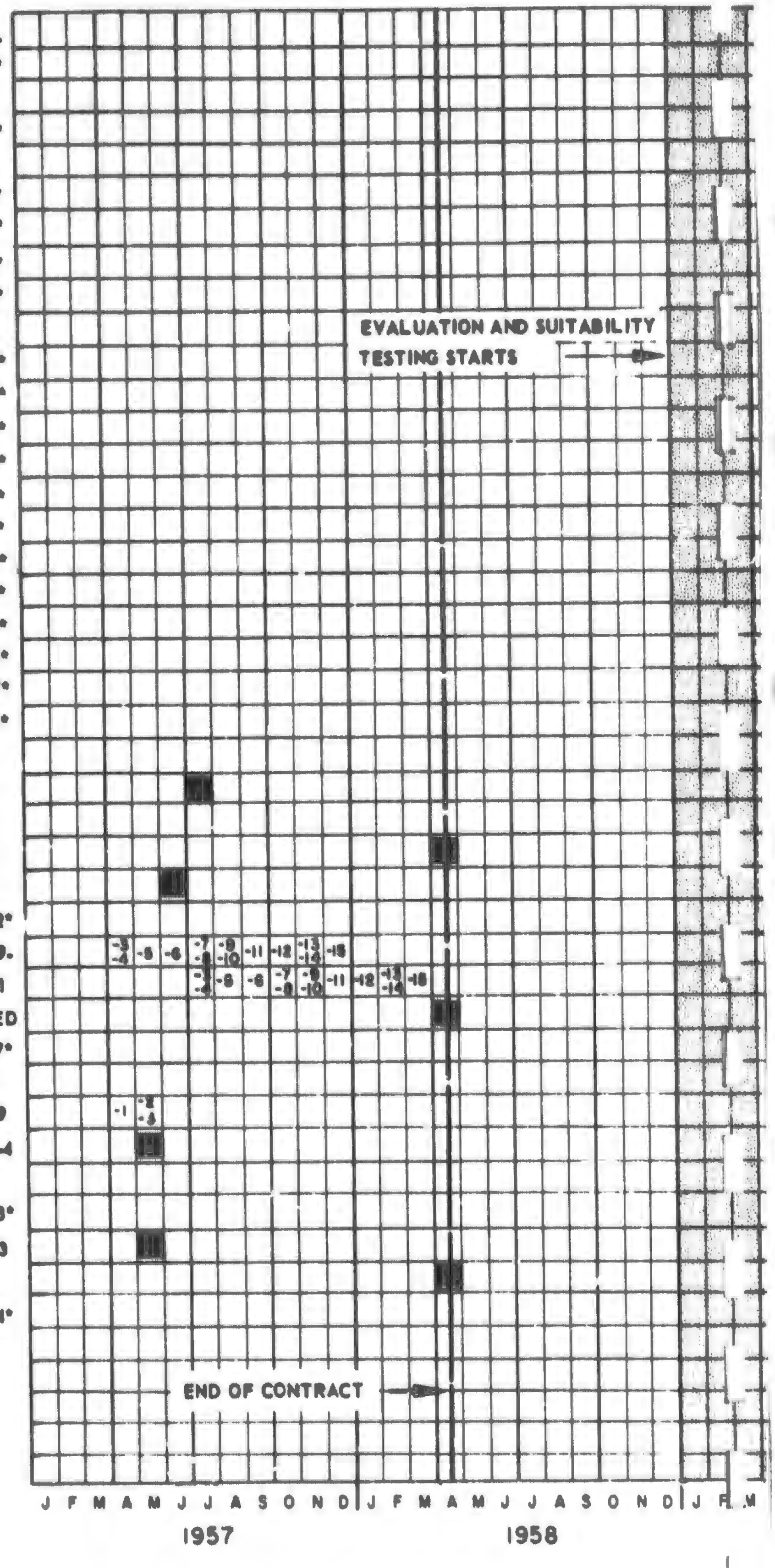
TECHNICAL DATA

REPORTS:	REPORT NO.
AERODYNAMICS, EST. PERFORMANCE	1183*, 1489*
AERODYNAMICS, EST. STABILITY AND CONTROL CHARACTERISTICS	1184*
AERODYNAMICS, CALCULATED STABILITY AND CONTROL CHARACTERISTICS	1495*
COMPARTMENT HEATING AND COOLING	1812*
OPERATIONAL ANALYSIS	1557-1*
STANDARD MISSILE CHARACTERISTICS CHART	1809*
EXPANSION OF HADC GROUND FACILITIES FOR TELEMETRY	1070*
TELEMETER	1141 (Appendix)*
FACILITIES REQUIRED BY LOCKHEED MSD AT AFMTC	1099*
FACILITIES REQUIRED BY LOCKHEED MSD AT HADC	1026*
TRAINING PROGRAM	1619*
WEIGHT AND BALANCE, ESTIMATED	1146*
WEIGHT AND BALANCE, CALCULATED	1881*
FEI DATA ON T.V. ADAPTABILITY	1696*
FEI SURVEY	1089*
FEI SYSTEM EVALUATION	1110*
FEI PROPOSALS	1111*, 1227*
AIRBORNE ELECTRICAL POWER UNIT	1123*
RADIATED AND CONDUCTED RADIO NOISE INTERFERENCE	
ALPHABETICAL AND NUMERICAL INDEX OF CFE DRAWINGS	
FLIGHT CONTROL SYSTEM	
HYDRAULIC FLIGHT CONTROL SYSTEM PROPOSAL	1702*
FLIGHT TEST PLAN	1599-
FLIGHT TEST EVALUATION	3071
FINAL FLIGHT TEST	NOT ASSIGNED
WING VIBRATION TEST	1507*
PRELIMINARY GROUND VIBRATION AND FLUTTER SURVEY	1859
FINAL VIBRATION AND FLUTTER SUMMARY	1859-4
PROPOSED ELECTRONICS DEVELOPMENT PROGRAM (GUIDANCE SYSTEM)	1073*
GUIDANCE SYSTEM	1813
LOGISTIC SUPPORT LIST	
PRESSURE AND TEMPERATURE CONTROL SYSTEM	1764*



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DASH NUMBERS SHOWN ARE DASH NUMBER ISSUES TO BASIC REPORT NUMBER.

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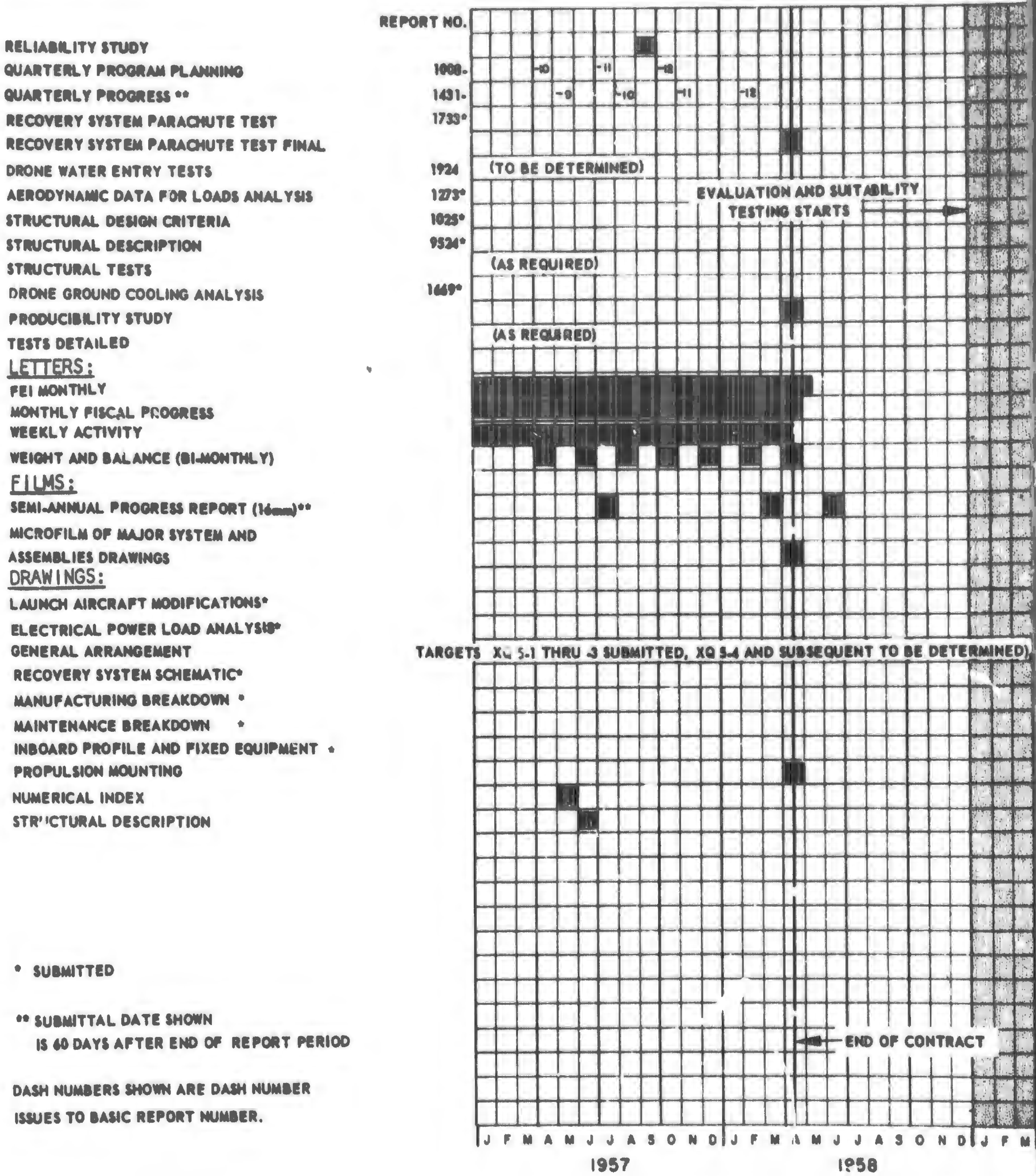

* SUBMITTED

** SUBMITTAL DATE SHOWN IS 60 DAYS AFTER END OF REPORT PERIOD

DASH NUMBERS SHOWN ARE DASH NUMBER ISSUES TO BASIC REPORT NUMBER.

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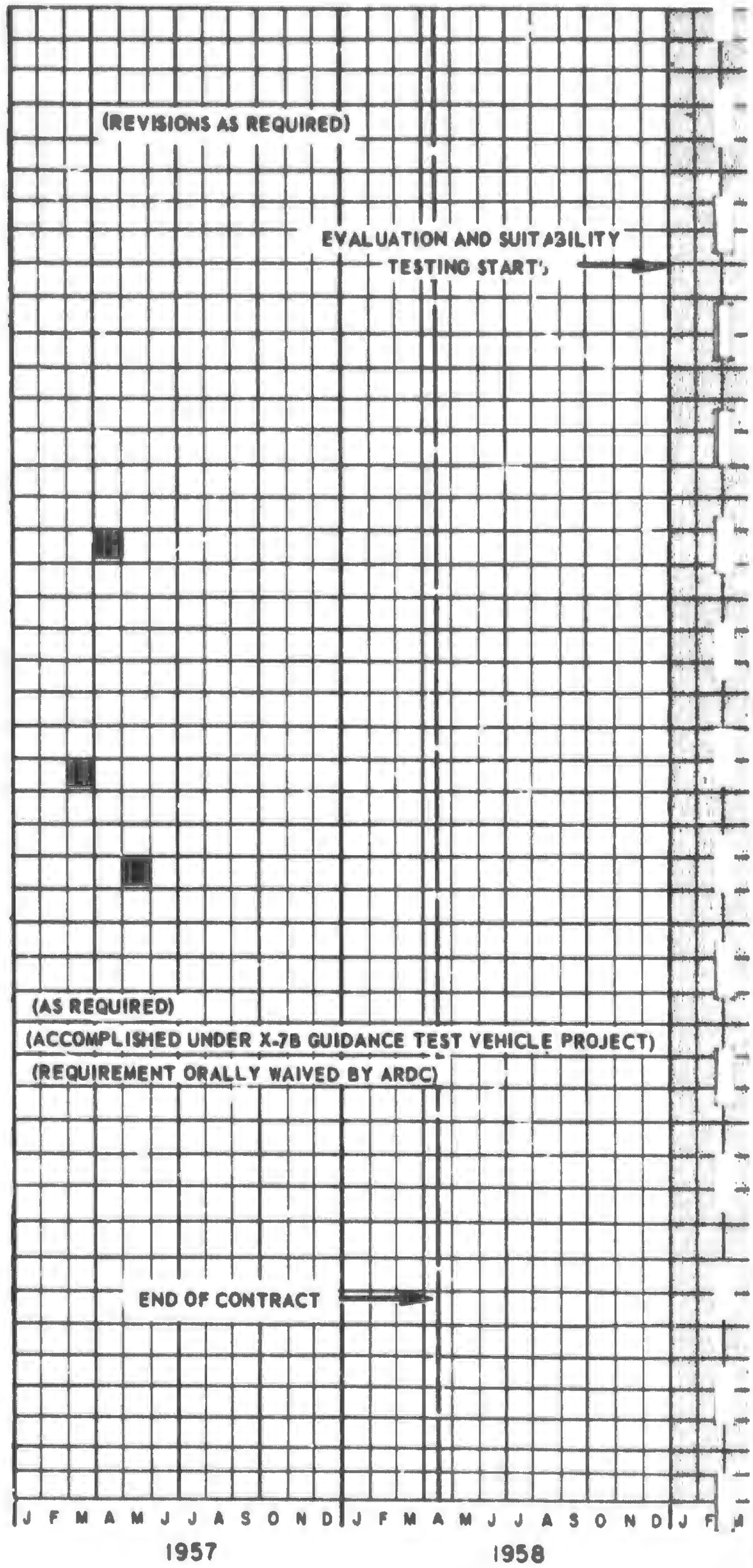
SPECIFICATIONS:

	REPORT NO. XQ-5	REPORT NO. YQ-5
WEAPON SYSTEM	1770*	
TRAINING AIDS		1621*
SUPPORT EQUIPMENT	1968*	1612*
LAUNCH AIRCRAFT	1769*	1627*
PACKAGING DESIGN PROPOSAL		1629*
DETAIL MODEL	9524*	1611*
BOOSTER ROCKET PERFORMANCE	1262*	
FLIGHT CONTROL	1760*	
HYDRAULIC SYSTEM		1614*
HYDRAULIC AUTOPILOT		1615*
FLIGHT CONTROLS	1068*	
REMOTE FLIGHT CONTROL SYSTEM	*	
PRELIMINARY FLIGHT CONTROL	1306*	
PRESSURE-TEMPERATURE CONTROL	1764	1622*
AIRBORNE POWER UNIT	1761*	1616*
FIRING ERROR INDICATOR		
DETAIL SUBSYSTEM	1333*	1625*
RADAR EQUIPMENT	1370*	
AIRBORNE ANTENNAE	1434*	
TARGET AREA AUGMENTATION	1768*	1626*
WIRING HARNESSES	1765	1623*
RECOVERY SYSTEM	1636*	1617*
FUEL SYSTEM	1763*	1618*
COMMAND GUIDANCE SYSTEM	1490	1628*
TELEMETER	1766*	1624*
TARGET ENVIRONMENTAL	3002*	
GROUND SUPPORT EQUIPMENT ENVIRONMENTAL	3006*	
OTHER SUBSYSTEMS		
WIND TUNNEL		
FLIGHT TEST		



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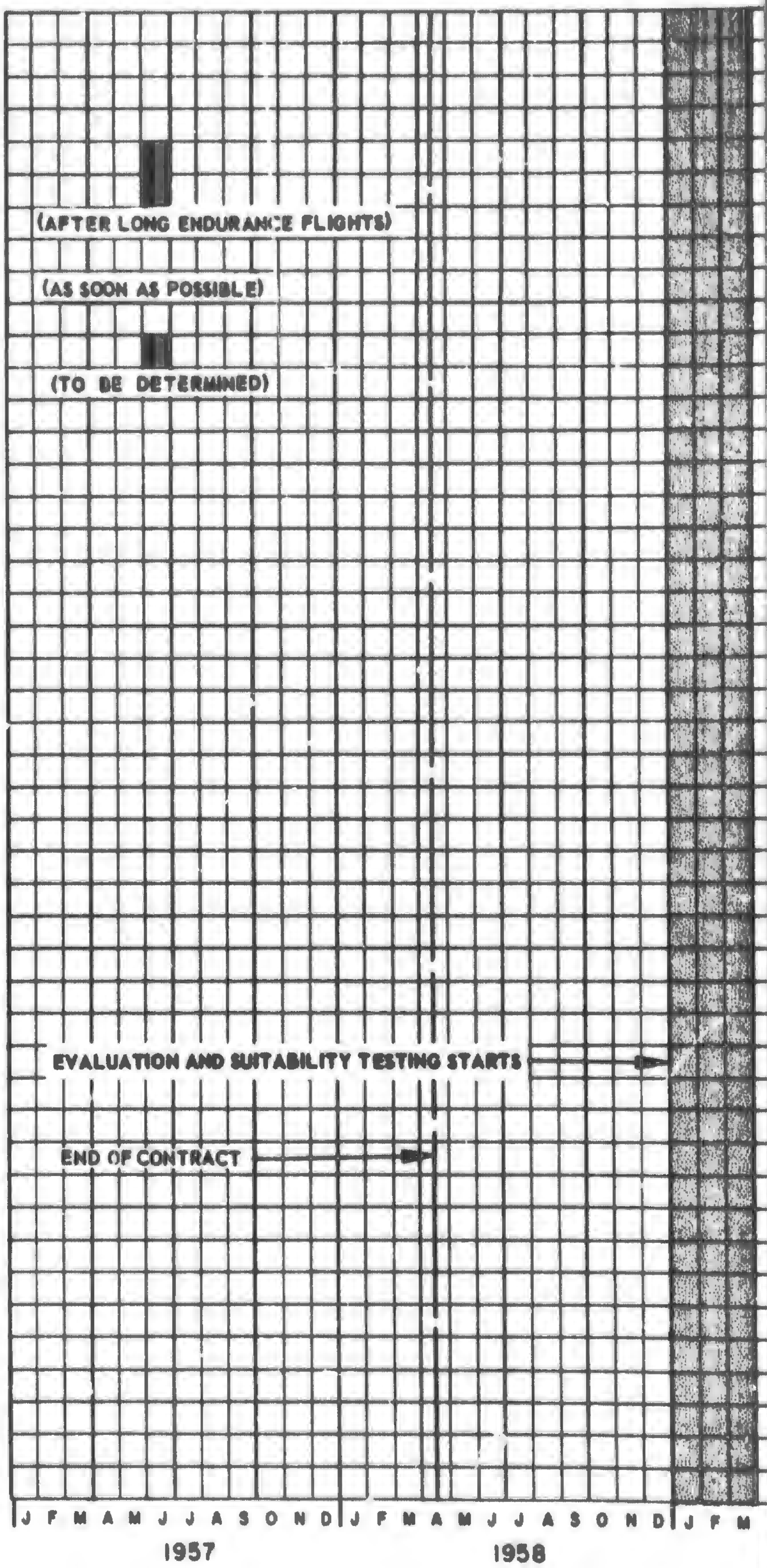
ITEMS IN RESPONSE TO DEI NO. 1

RFA			REPORT NO.
7	WATER RECOVERY SYSTEM	(LETTER AND REPORT)	1879*
11	FUEL SYSTEM SERVICING	(LETTER)	LMSD/21689*
12	PARACHUTE RECOVERY	(REPORT)	
13	FUEL SYSTEM	(LETTER)	
15	FUEL TANK INSULATION	(LETTER)	
17	PARACHUTE RECOVERY SYSTEM ENVIRONMENT	(LETTER AND REPORT)	
18	AIRFRAME INSPECTION AND ACCESSIBILITY	(LETTER)	
20	WIND TUNNEL TESTS	(LETTER)	



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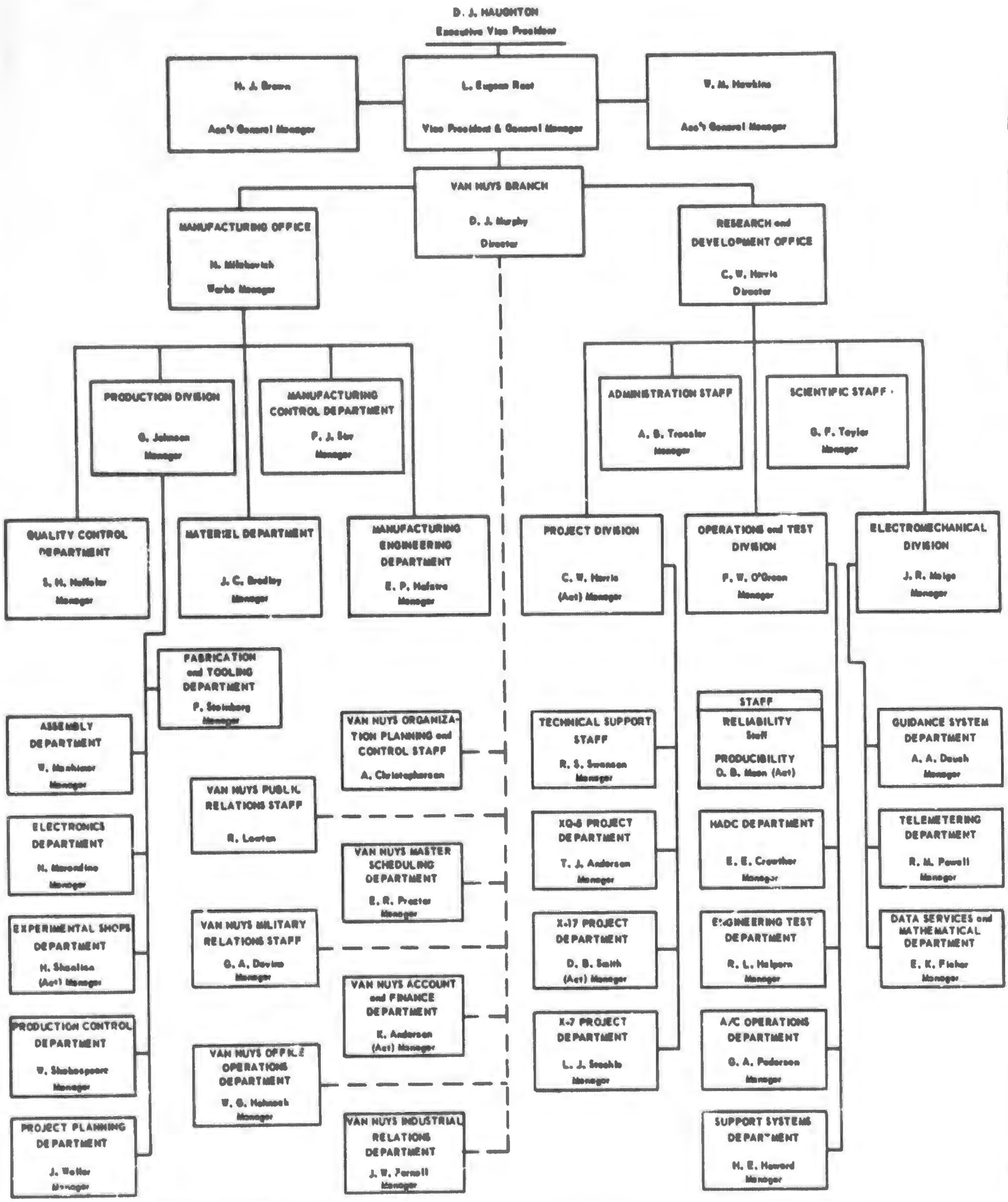
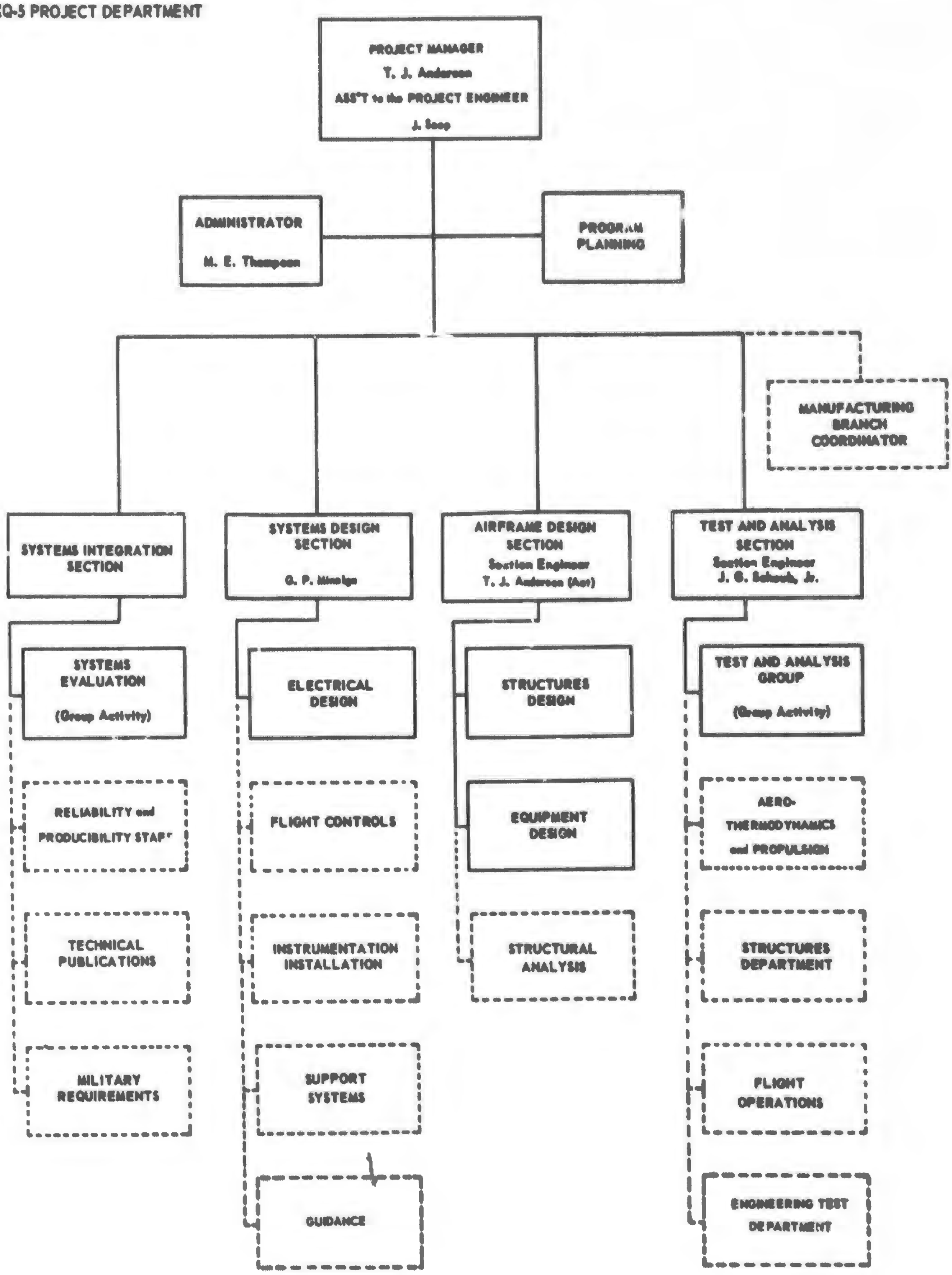
ORGANIZATION



LEGEND: ———— Line Authority.
— — — Administration direction from Van Nuys Branch and functional direction from the respective functional Branch in the Bay Area.

XQ-5 PROJECT DEPARTMENT



FUTURE PLANNING

The program plan outlined in the preceding pages has presented the basic requirements and schedules for achieving an effective and operationally suitable Q-5 Drone System in minimum time and at minimum cost. In the course of development, possibilities for improvement to the basic system are uncovered. It is the purpose of this section to briefly outline current items for improvement which may prove of significant value. Cost and time estimates are yet to be made.

Items for future planning considerations are:

1. Provisioning the launch aircraft to carry two drones and launch them individually.

2. Providing a system for retrieving the drone from water. An important part of this system is the use of r-f transmitting and receiving equipment and dye markers for locating the drone.

3. Providing automatic flight programming to permit accurate flight control by relatively unskilled personnel, including automatic drag brake control.

4. Structural improvements, including quick disconnect joints and access panels, built-in booster alignment, and a weight reduction program.

5. Designing and developing means of packing parachutes at the factory to provide the proper quantity of reliable chutes for operational use.

6. Target area augmentation and countermeasures techniques and equipment required to simulate a broad spectrum of potential threats.

7. Providing drone system operation by contractor-furnished personnel. The non-combatant nature of the drone operation has prompted consideration of contractor-furnished complete drone services.

8. Installation of Sperry Microwave guidance system.