DIN: 50196-148-2
128 Pages
Copy #1

~~SECRET~~ SPECIAL HANDLING

[redacted]

V I P

PRESENTATION

AUGUST 9, 1967

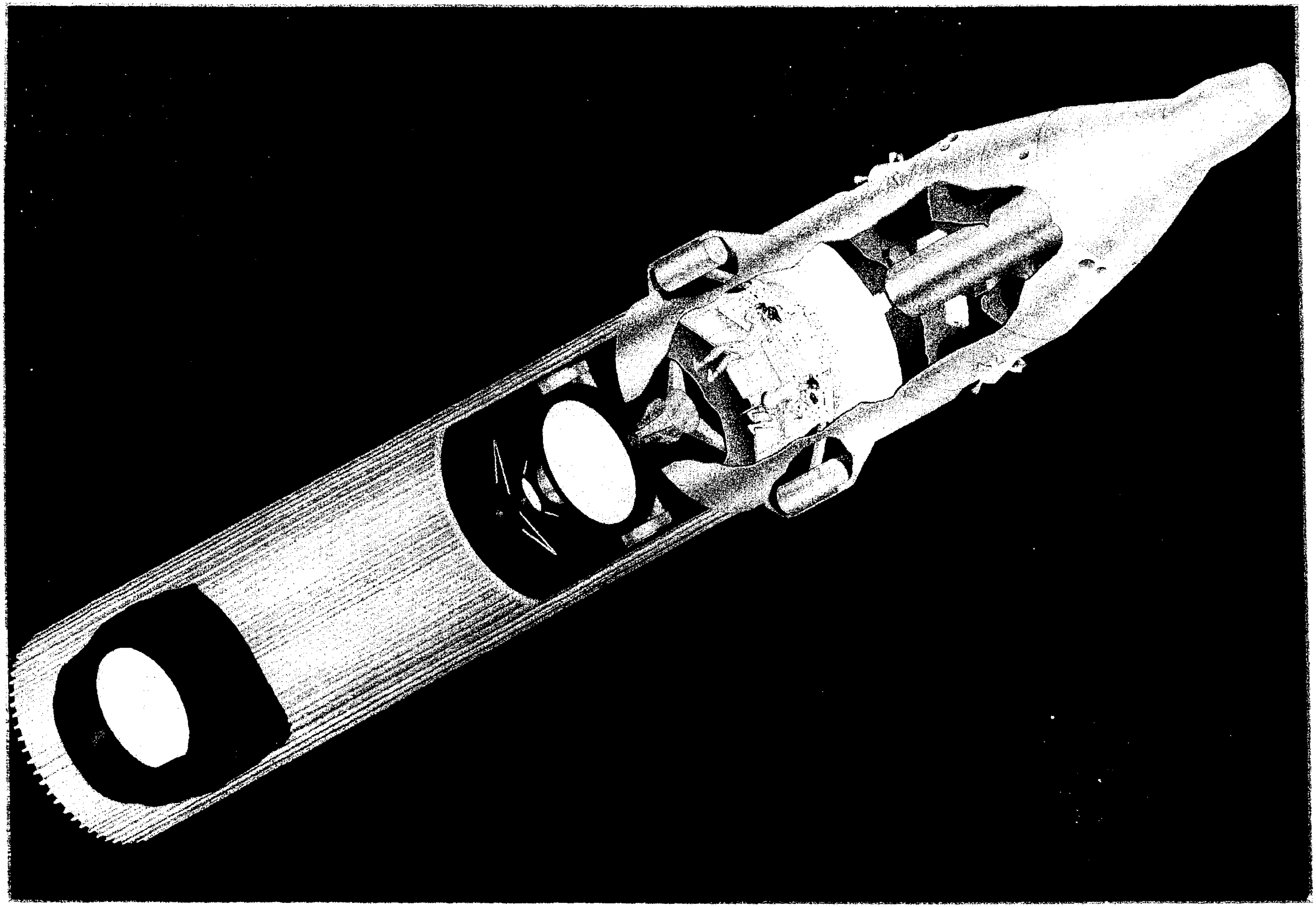
~~SECRET~~ SPECIAL HANDLING

ORBITING VEHICLE LAYOUT

POINT TO BE MADE

MOL is a high performance photographic intelligence reconnaissance satellite, utilizing man to aid in the R & D cycle and is a natural outgrowth of previous Air Force reconnaissance satellites.

- Identify major segments: Gemini, Laboratory Module, Mission Module
- Mission Module (including operational consoles in lab) performs functions for achieving [redacted] resolution
- Functions include photography, navigation and control, temperature control, structural vibration control
- These functions were performed on other satellite programs such as Discoverer and other reconnaissance satellites
- The technology required for MOL is based on that developed on other Air Force and NASA programs



AGENDA

POINT TO BE MADE

Briefing is aimed at describing how MOL will achieve [redacted] resolution photography

---

- Mockup Area - discussion of program and performance objectives
  - organization, schedules, funding
  - technical considerations
  - related experience

- N & C Brassboard Area - Development testing of tracking mirror key elements
  bearings and lubricants
  drives
  gyros
  electronics

- Simulation Area - Development of operational and mission procedures and time-lines
  Computer software for mission computations
  mission operations/hardware/man interface

- Eastman Kodak - Photographic and optical equipment and system

AGENDA

GENERAL ELECTRIC

- MOCK-UP (HERE)

    PROGRAM OBJECTIVES

    TECHNICAL RESOURCES AND CONCLUSIONS

- NAVIGATION AND CONTROL

    DEVELOPMENT TESTS

- SIMULATION

    MISSION OPERATION DEVELOPMENT

EASTMAN KODAK

- PHOTOGRAPHIC AND OPTICAL SYSTEM

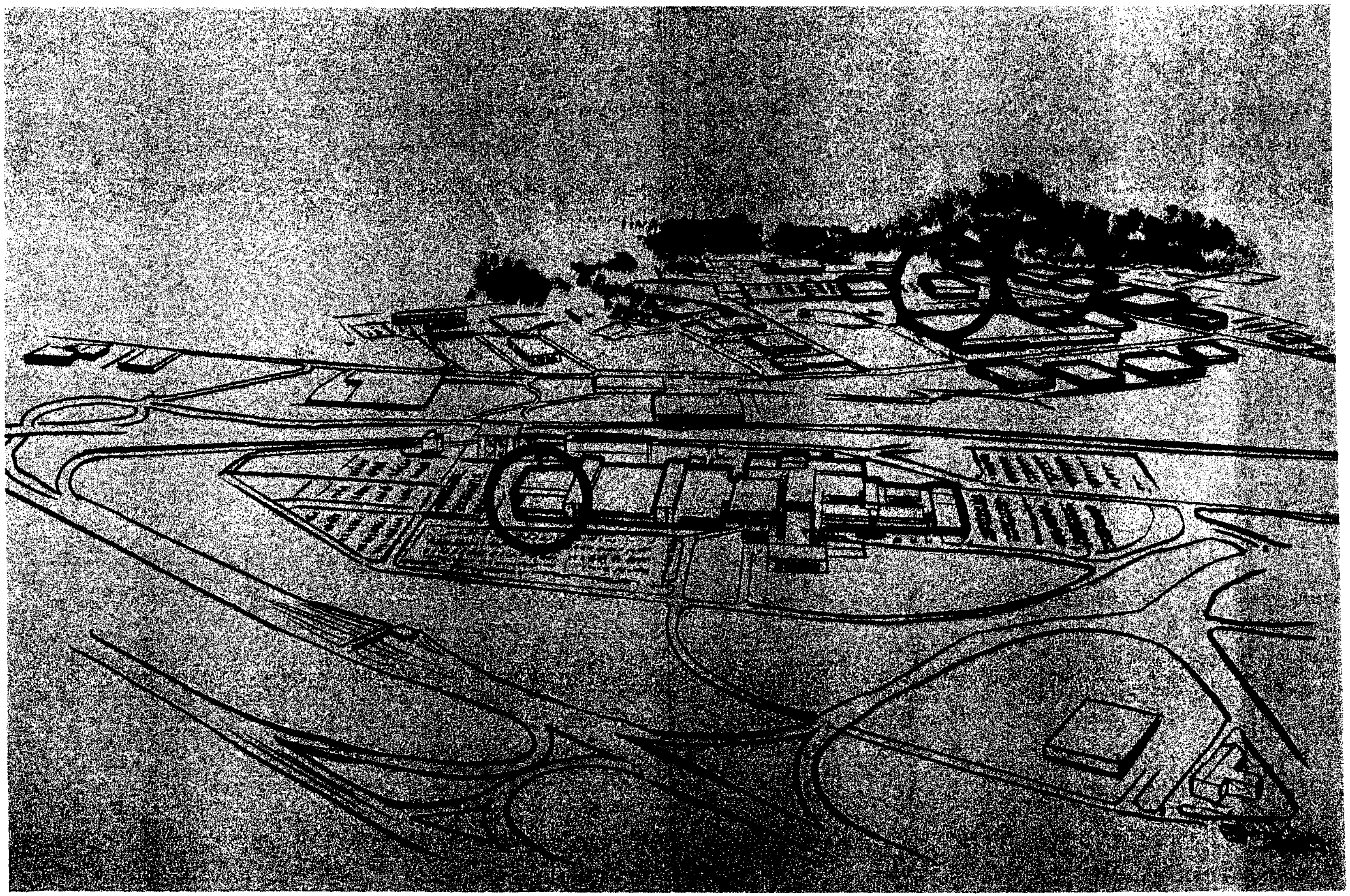
PICTURE OF VALLEY FORCE AREA

POINT TO BE MADE

GE-MOL facilities located close together for efficient operation.

. Show areas where GE portion of briefing will take place.

GENERAL ELECTRIC COMPANY
MISSILE AND SPACE DIVISION



PERFORMANCE OBJECTIVES

POINT TO BE MADE

[redacted] Resolution [redacted] Unmanned

- Aim at, track and take photos of 1500 cloud free targets

  5 stereo pairs per target for a total of 15,000 photos

  More targets are possible with fewer photos per target

- 60 days operation, unmanned, is feasible since off loading of equipment and supplies to support the pilots makes weight and volume available for more propellant for orbit maintenance, more fuel for fuel cells, and more film for additional photos.

PERFORMANCE OBJECTIVES

- OBTAIN HIGH RESOLUTION PHOTOGRAPHIC INTELLIGENCE OF SIGNIFICANT TARGETS
  - [redacted] RESOLUTION [redacted]
  - 1500 CLOUD FREE TARGETS
  - 30 DAYS ON-ORBIT, MANNED/UNMANNED ADAPTABLE TO 60 DAYS ON-ORBIT, UNMANNED

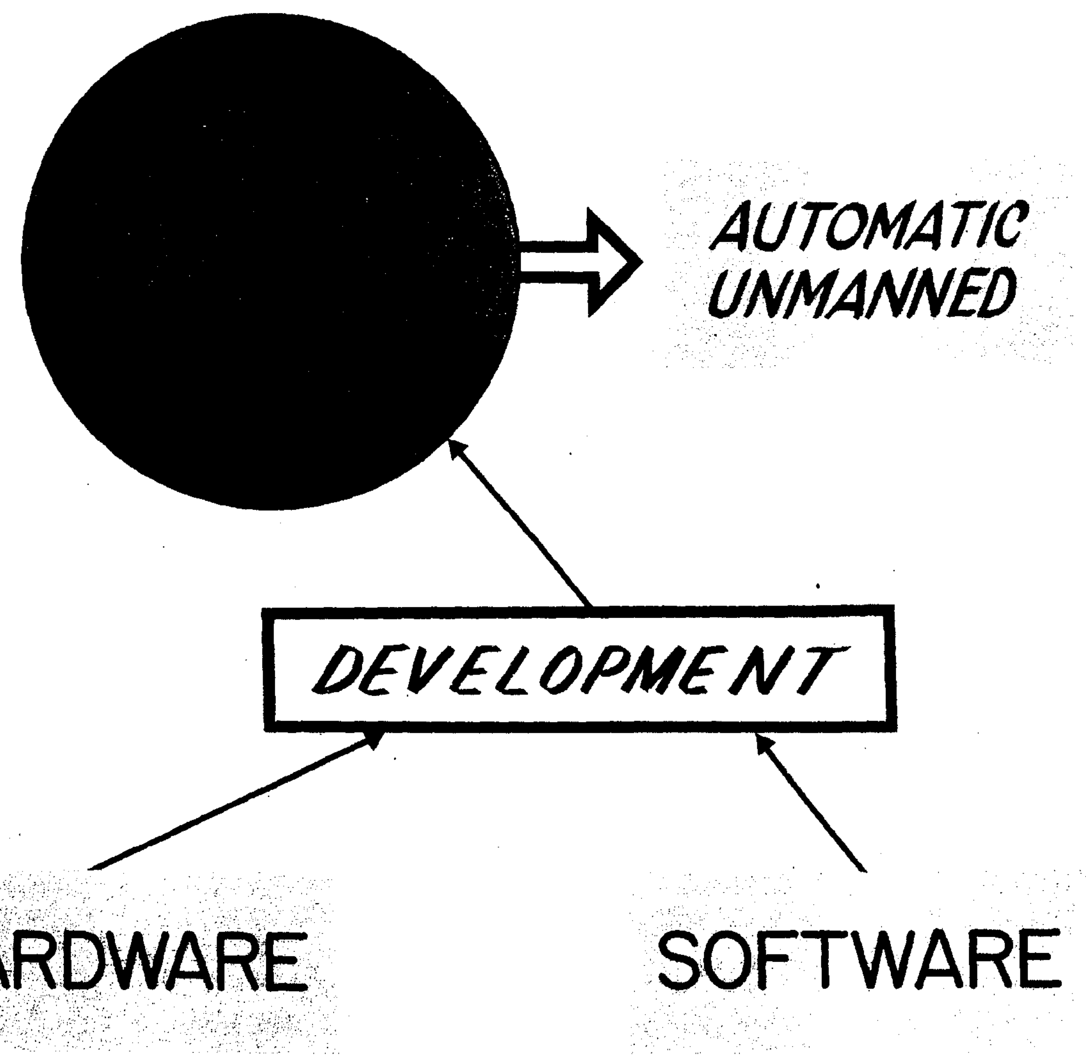
when system is mature

PROGRAM OBJECTIVES (WITHOUT MAN)

POINT TO BE MADE

[redacted] resolution [redacted] manned, requires hardware and computer program software development

PROGRAM OBJECTIVES



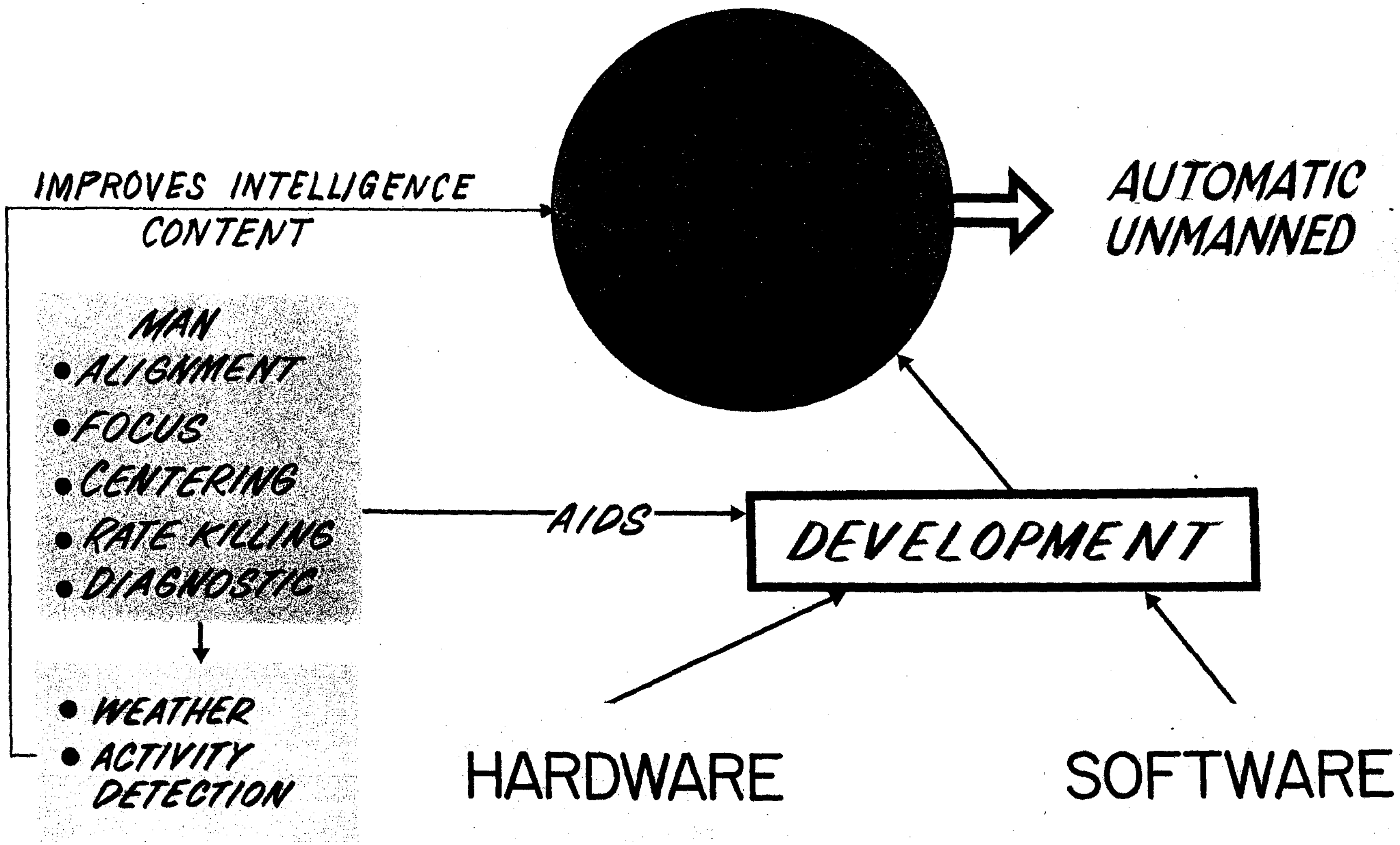
PROGRAM OBJECTIVES (WITH MAN)

POINT TO BE MADE

Man can shorten the development cycle for the automatic mode and can serve as a redundant element to the tracking mirror control system. Thus, the program can achieve mission objectives by obtaining quality photographs in early flights while simultaneously solving development problems.

- Observes alignment of optical elements and can record data for later use in design refinements.
- Focus accuracy observed by developing selected photos on-board, making adjustments for later incorporation in design.
- Observes target location and can correct its centering manually. Correction recorded in computer which updates stored data, and telemetered to ground for update of target coordinates and navigation data.
- Rate killing can be done manually and overrides the Image Velocity Sensor. Manual corrections recorded in computer which updates stored equations and records magnitude of correction. This data is used for design updates of IVS and control loop.
- Diagnostic functions include monitoring of equipment performance, pinpointing problem areas within accessible complex components such as the computer and clearing jammed film in the camera.
- Detection of cloud cover over primary target and switching to preprogrammed alternate, plus activity detection in specific portions of target areas and, if desired, centering them increase the intelligence content of the photographs.

PROGRAM OBJECTIVES



GE ROLE

POINT TO BE MADE

To make the photographic system work in orbit and meet performance requirements.

- Incorporate the static photographic section into the dynamic orbital system.
- Environmental control needed to maintain temperatures of the tracking mirror and tracking mirror bay within close tolerances even though the [illegible] may be at various altitudes, and during the time the vehicle is in the [illegible]k side of the earth.
- Command and control for navigation and target deck updates.
- Mission computations and dynamics - timelines and sequence of operations to move the mirror to point at the required targets and track them accurately for stereo photography.
- Man-machine interface - to utilize the pilots effectively in the development cycle.
- Displays and controls - part of the man-machine interface to display key component performance and to allow the pilot to operate target acquisition and tracking equipment.
- Electric power provided by McDonnell-Douglas must be distributed to the mission module equipment and regulated to specified tolerances over a wide range of power.
- The tracking mirror must be pointed accurately to the correct target at the correct time.

GENERAL ELECTRIC'S ROLE

EFFECTIVE UTILIZATION OF THE PHOTOGRAPHIC SECTION

- SYSTEMS ANALYSIS

  DYNAMICS
  THERMAL
  TRACKING MIRROR CONTROL

- MISSION ANALYSIS

  COMMAND AND CONTROL
  OPERATIONAL PROCEDURES

- INTEGRATION WITH ASSOCIATE CONTRACTORS

- UTILIZATION OF MAN

  DEVELOPMENT

6

RESOLUTION AND POINTING CONSIDERATIONS (A)

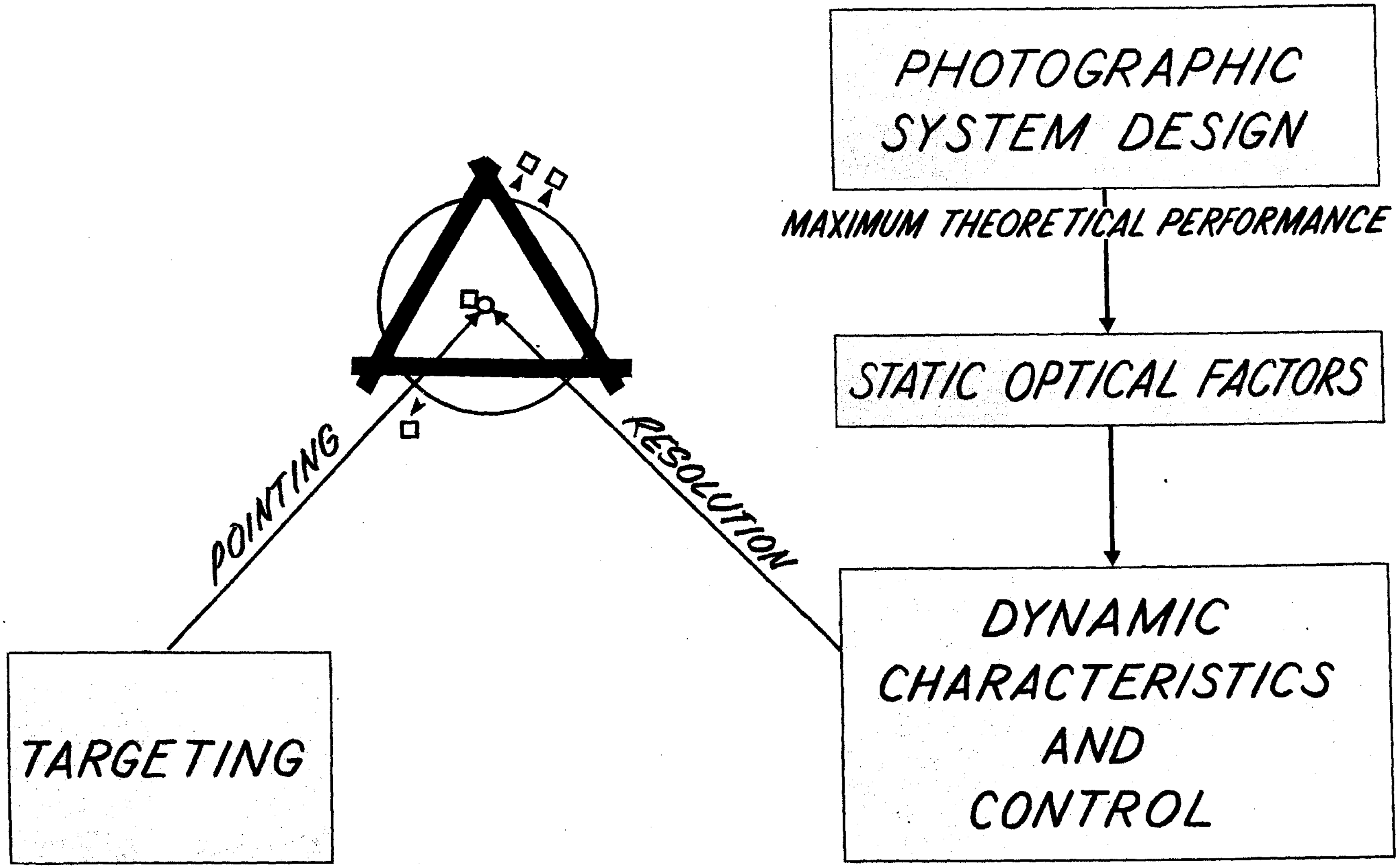
POINT TO BE MADE

Theoretical design, hardware characteristics and system control combine to provide resolution and photography of selected targets.

- Color code: yellow represents Eastman Kodak responsibilities; blue General Electric responsibilities.
- Optics must be accurately pointed to target to photograph it.
- [redacted] resolution must be obtained under specification conditions.
- The dynamic characteristics of the vehicle and allowable control tolerances must be accounted for in setting the requirements for the static photographic section.
- The optical hardware characteristics must also be accounted for when the photographic system design is established.
- Distance from the target, as measured by slant range, and the field of view contribute to the resolution that can be achieved; that is

  Resolution is proportional to distance from target
  Pointing accuracy and centering is a function of field of view

RESOLUTION AND POINTING CONSIDERATIONS



RESOLUTION AND POINTING CONSIDERATIONS (B)

POINT TO BE MADE

Describe the technologies and key equipments required to meet the program requirement.

. Color code is the same as the previous chart.

. Photographic system design and static optical factors will be discussed in detail by Eastman Kodak.

. Photographic system design factors provide the theoretical performance possible.
 . Lens aperture determines the amount of light capable of being admitted to the camera.
 . Focal length affects theoretical magnification.
 . Film determines the amount of fine detail that can be resolved.
 . Range affects the net resolution that can be achieved in conjunction with the above.

. Static optical factors define the affect that the hardware has on theoretical performance and is a function of material quality, workmanship and allowable manufacturing tolerances.
 . Optical quality defines the affect of the glass in distorting the light and reducing its intensity.
 . Focus adjustment has tolerances and thus introduces some modification to the sharpness of the image.
 . Contrast of the target will vary and this will affect the amount of detail that may be detected.
 . Exposure time has tolerances and thus affects the quality of the image on the film.
 . Optical alignment affects the centering of the incident light on the camera and film and tolerances thereon affect performance.
 . Temperature control of the optics and surrounding structure is required to keep glass distortion to acceptable levels.

. The dynamic characteristics of the vehicle and optics and their control are controlled by the functions listed on the chart.
 . Vehicle attitude rates are controlled by the McDonnell-Douglas Attitude Control and Translation Subsystem and their magnitudes are transmitted to the computer.
 . Mission computations are performed by the on-board computer, which, together with data from the star tracker and the image velocity sensor, provide commands to the tracking mirror, controlling its tracking rate.
 In addition, the computer is programmed to control all mission operations, their sequence and timing.
 These may be modified by the pilot in making corrections and by ground command.
 . Image velocity sensing is necessary, especially in the automatic mode, to limit the relative motion of the line-of-sight at the center of the format so that resolution is not degraded beyond allowable limits. Two image velocity sensors, which are redundant, will perform this function by sensing this motion, converting it to an electrical signal to the computer, which in turn modifies the tracking mirror rate. During manned flights, the pilot may also observe relative image velocity and, through his manual controls, reduce it. His corrections, in addition to those provided by the image velocity sensor are recorded and transmitted to the ground, where they will be used to correct the design of the image velocity sensor.
 . Vibration of all structural elements are specified in terms of amplitude and frequency limits in order to limit image motion. Within the specified limits, the tracking mirror control will modify the tracking mirror rate to compensate for vibration, utilizing the image velocity sensor, the rate gyros and the computer.
 The crew can also perform this function.
 . The temperature of the tracking mirror bay and tracking mirror must be maintained within close tolerances ($70^{o}F \pm 5^{o}$) to reduce optical distortions to acceptable values. The temperature gradient through the tracking mirror must be maintained to $0.1^{o}F$ per foot or less to assure that its glass surface is flat to within 1/20 of a wavelength of light (average).
 This control must take place under all conditions of sun angle, vehicle attitude, during photography when the thermal door is open and during the night side of the orbit.
 . Image motion compensation across the format is performed by Eastman Kodak and corrects for differences in the motion of the line-of-sight away from the center of the format.

. The targetting functions are performed by the functions listed.

. The command and control, ground based computer program can supply corrections to the tracking mirror rate, based on evaluation of tr. cking data, pilot observations and other. In addition, the target deck may be changed to allow a different set of targets ~~to be programmed and photographed~~. Pr oper constraints are automatically placed on the sequencing of targets to be compatible with vehicle capabilities.

. Target location is pre-programmed into the on-board computer as a table of coordinates using geodetic data and other observations. The sequence of targets to be photographed is also preprogrammed.

. Based on direct observations, the pilot can correct the pointing angle of the tracking mirror and this correction, together with orbit parameters, vehicle location, and star tracker data, allows the computer to compute corrected coordinates for that target.

. Navigation combines target location on the ground with vehicle location in orbit. Tracking by ground station provides data for periodic updating of orbit parameters, which then locates the vehicle with respect to the targets. An on-board drag accelerometer provides continuous data on atmospheric drag so that this effect on orbit characteristics can be continually updated by the on board computer and, via telemetry, by the Mission Control Center. This information is utilized by the vehicle Attitude Control and Translation Subsystem to correct the orbit by periodic firing of its thruster. The computer also modifies the pointing commands to the tracking mirror based on this data.

The pilots may play a role in this function by direct observation of the target and if required, may correct the tracking mirror attitude by manual control. This correction is operated on by the computer and the results serve to improve the preprogrammed orbit equations.

Navigational accuracy, including the on-board drag accelerometer, require that the vehicle be located to within 0.1 nautical mile of a predetermined position $2\frac{1}{2}$ orbits in advance. With the pilot, this accur cy can be with reference to a given target.

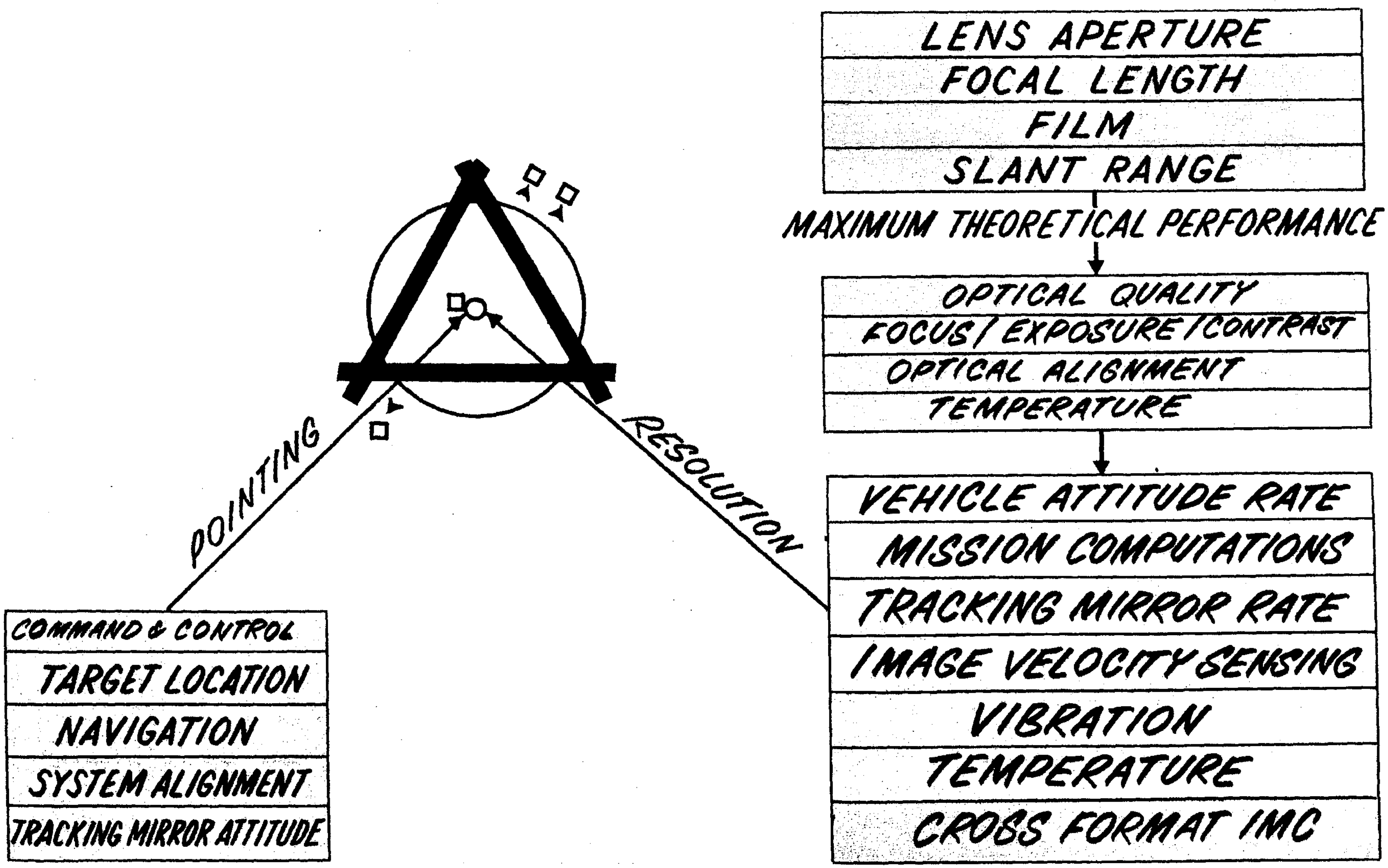
. System alignment concerns the alignment between the star tracker and the tracking mirror and between the primary optics and the tracking mirror. Changes in alignment are sensed by an electro-optical device and sent to the computer which modifies the tracking mirror attitude.

The pilot participates in this function by direct observation of alignments and changes in the centering of the target and can manually make corrections.

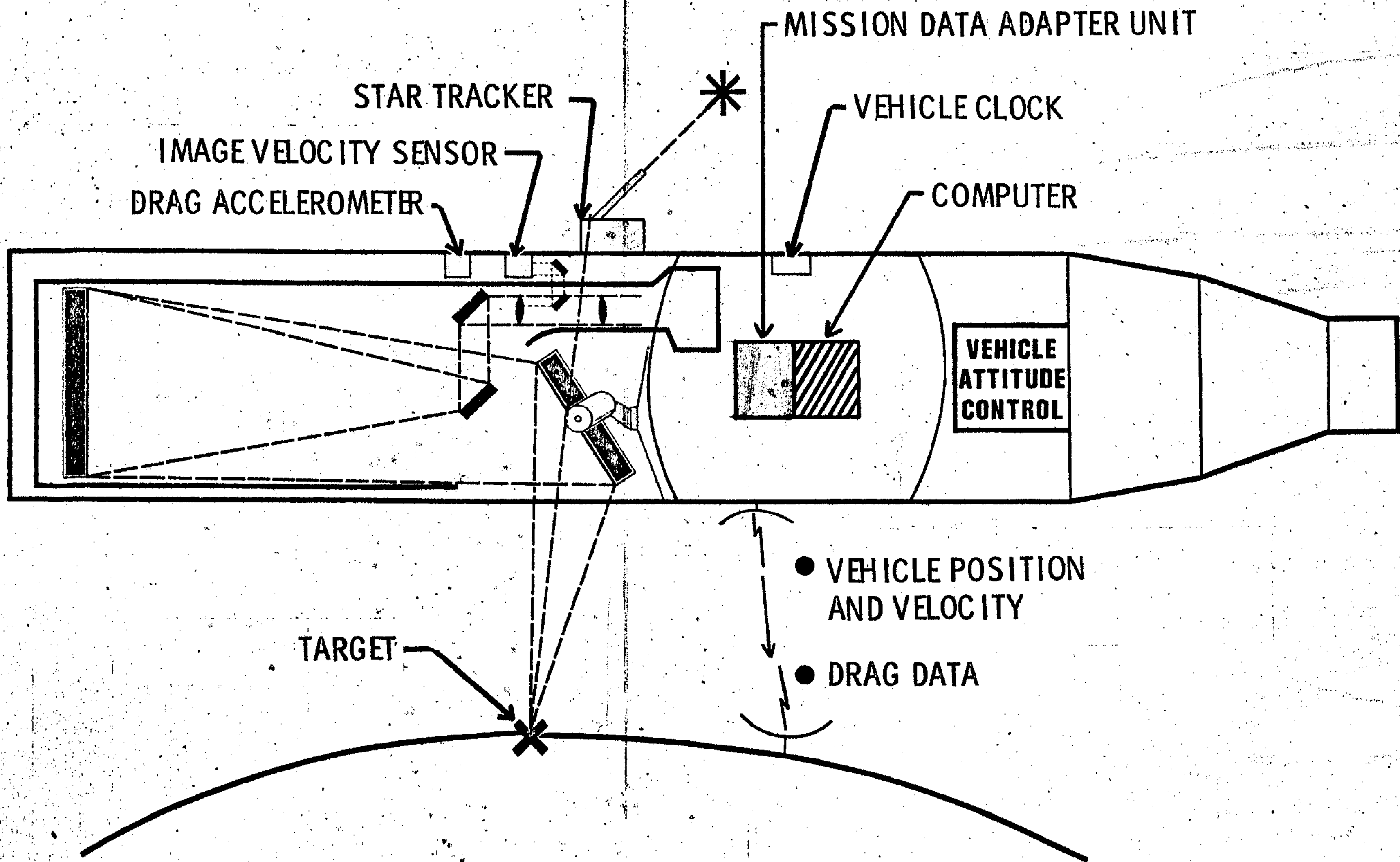
. Tracking mirror attitude is a result of the above considerations and is computed on board and commanded by the computer. This is performed automatically, using navigation, target location, star tracker and vehicle attitude data. The pilot can make manual corrections if required.

SPECIAL HANDLING

RESOLUTION AND POINTING CONSIDERATIONS



POINTING AND TRACKING OPERATION



2Y

GE MISSILE AND SPACE DIVISION SYSTEMS EXPERIENCE

POINT TO BE MADE

Functions to be performed by MOL to obtain [redacted] resolution have been developed and demonstrated on other Air Force and NASA programs. General Electric is confident that performance requirements will be met.

- Precision controls on Orbiting Astronomical Observatory (0.1 second of arc accuracy)
- Recon satellites (201, 206)
- Satellite inspection vehicle (437 AP)
- Nimbus weather satellite

GE MISSILE AND SPACE DIVISION SYSTEMS EXPERIENCE
(RELATED TO MOL REQUIREMENTS)

FUNCTION	PROGRAM EXPERIENCE
• NAVIGATION & TRACKING MIRROR CONTROL	• ORBITING ASTRONOMICAL OBSERVATORY • NIMBUS • RECONNAISSANCE SATELLITES
• VIBRATION (STRUCTURES)	• NIMBUS • MANEUVERING BALLISTIC RE-ENTRY VEHICLE • RECONNAISSANCE SATELLITES
• TEMPERATURE CONTROL	• NIMBUS • DISCOVERER • MANEUVERING BALLISTIC RE-ENTRY VEHICLE • RECONNAISSANCE SATELLITES
• COMPUTER PROGRAMS	• NIMBUS • RECONNAISSANCE SATELLITES • EK-LOCKHEED VEHICLE

POINTING AND TRACKING OPERATION CHART

POINT TO BE MADE

Schematic of functions and key equipments described in resolution and pointing considerations.

- Optical alignment between primary mirror at rear of vehicle [illegible] camera continually adjusted automatically.

- Computer commands tracking mirror initial pointing by using
  - updated ground tracking data
  - drag accelerometer data
  - star tracker data
  - alignment data between star tracker and gimbal, primary optics and gimbal
  - vehicle attitude data

- Computer commands tracking mirror tracking rates by using
  - vehicle rate data
  - orbit parameters
  - image velocity sensor data
  - rate gyro data

LONG LIFE RELIABILITY

POINT TO BE MADE

Life requirements for MOL fall within General Electric experience and achievements and that they will be met.

LONG LIFE RELIABILITY

GE PROGRAM	REQUIRED	ACHIEVED
• BOOSTER GUIDANCE	4 MIN	4 MIN
• REENTRY VEHICLES	30 MIN	30 MIN
• DISCOVERER	120 HRS	120 HRS
• 201, 206	132 HRS	192 HRS
MOL REQUIREMENT	720 HRS MANNED 1440 HRS UNMANNED	
• NIMBUS 1	1000 HRS	504 HRS
• NIMBUS 2	4420 HRS	10,836 HRS

KEY GE COMPONENTS THAT MUST WORK

BEFORE MAN IS REMOVED FROM PROGRAM

POINT TO BE MADE

These are portions of tracking mirror control loop where man, with the Acquisition and Tracking Subsystem, provides functional redundancy and allows [redacted] resolution to be obtained.

- Image Velocity Sensor is the component which replaces man for automatic operation and is required to enable the tracking mirror control to effectively reduce smear to the order of [redacted] resulting in [redacted] resolution.

- Electro optical technology is extended to provide line-of-sight velocity sensing and converting it to a proportional output voltage.

- Star tracker and rate gyros are state-of-the-art components and together with the other control elements and allowable vehicle vibration, controls the smear to about [redacted] resulting in a resolution of about [redacted] Therefore, their risk is assessed "Low."

- Risk on Image Velocity Sensor is assessed "High" because it is the one component that will allow the system to perform to requirements in the automatic mode.

KEY GE COMPONENTS THAT MUST WORK

BEFORE MAN IS REMOVED FROM FLIGHT PROGRAM

COMPONENT	CONTRACTOR	TECHNICAL RISK
• IMAGE VELOCITY SENSOR	• GOODYEAR • ITEK	• HIGH
• STAR TRACKER	• KOLLSMAN	• LOW
• RATE GYROS	• HONEYWELL	• LOW

KEY GE COMPONENTS THAT MUST WORK
MANNED AND UNMANNED

POINT TO BE MADE

These elements must work even where man can provide some functional redundancy in order to obtain the required large quantity of high quality photographs

---

- Computer and Mission Data Adapter Unit provide for automatic sequencing of target commands. Man can act in functional redundant capacity but cannot act as rapidly in recognizing next target and alternates and manually slewing tracking mirror to them in time over the thirty day period. The risk on these elements is assessed "low" since they are redundant and are state-of-the-art.
- The control electronics must function even if man is in the loop because his manually originated commands activate their circuitry for driving the tracking mirror.
  The risk here is assessed "low" because of redundancy and state-of-the-art.
- The tracking mirror gimbal structure is designed for beryllium and large structural elements of this material have not been flown before. However, development of large structures with this material has shown that it can be fabricated, assembled and tested successfully under static and dynamic load conditions. As a result of the above, its risk is assessed "Moderate".
- The tracking mirror gimbal assembly consists of the structure, gyros, drives and bearings. These last must be able to function smoothly under variations in angular velocity that range from 12 degrees per second down to zero. No redundancy is incorporated in the bearings but testing on them is already underway with detail design data scheduled to be available three years before first flight.
  Therefore the risk here is assessed as "Moderate."
- The thermal door controls the heat flow into and out of the mission module and also, when open, admits the photographic system to view the target. The drives and actuators are similar to those used on the Maneuvering Ballistic Reentry Vehicle and are redundant. The mechanical design has adequate factors of safety. In addition, repeated cyclic testing is scheduled to be complete two years prior to the first manned flight.
  Therefore the risk assessment here is "Low."

KEY GE COMPONENTS THAT MUST WORK MANNED AND UNMANNED

COMPONENT	CONTRACTOR	THERMAL RISK
• ON BOARD COMPUTER	• INTERNATIONAL BUSINESS MACHINES	• LOW
• TRACKING MIRROR CONTROL ELECTRONICS	• GE SPACECRAFT DEPARTMENT	• LOW
• MISSION DATA ADAPTER UNIT	• RAYTHEON	• LOW
• TRACKING MIRROR ?	• McDONNELL	• MODERATE
• TRACKING MIRROR GIMBAL ASSEMBLY	• GE-MOL	• MODERATE
• THERMAL DOOR	• GE-MOL	• LOW ?

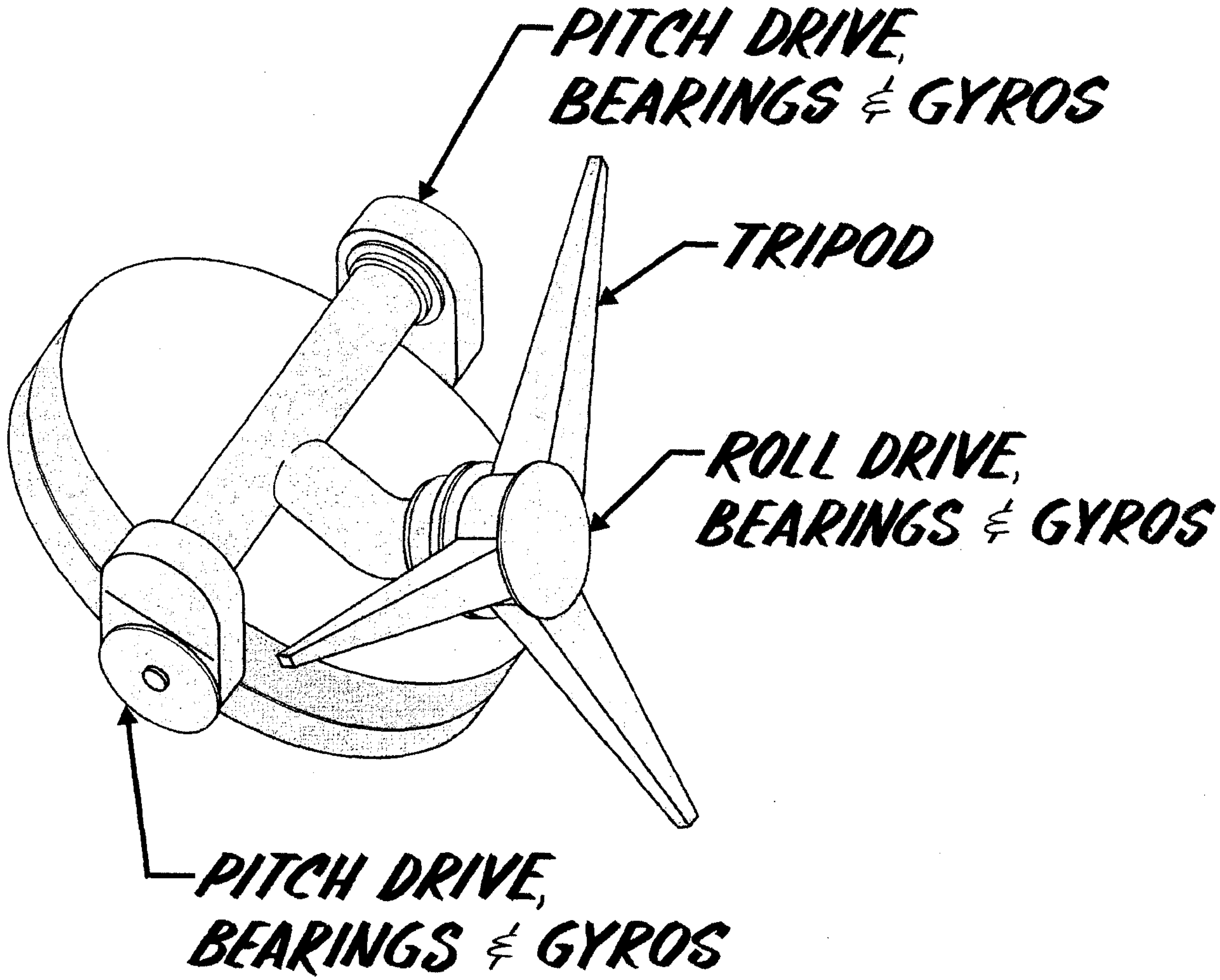
TRACKING MIRROR GIMBAL

POINT TO BE MADE

Illustrate the key areas of the gimbal that must be tested early to yield detail design data.

- Correlate pitch and roll bearings with test setups in Navigation and Control Brassboard area (CCF #4).

TRACKING MIRROR GIMBAL ASSEMBLY



59

REQUIREMENTS AND RESOURCES

- SCHEDULE
- FUNDING
- MANPOWER
- MOL PROGRAM ORGANIZATION
- SUBCONTRACTORS

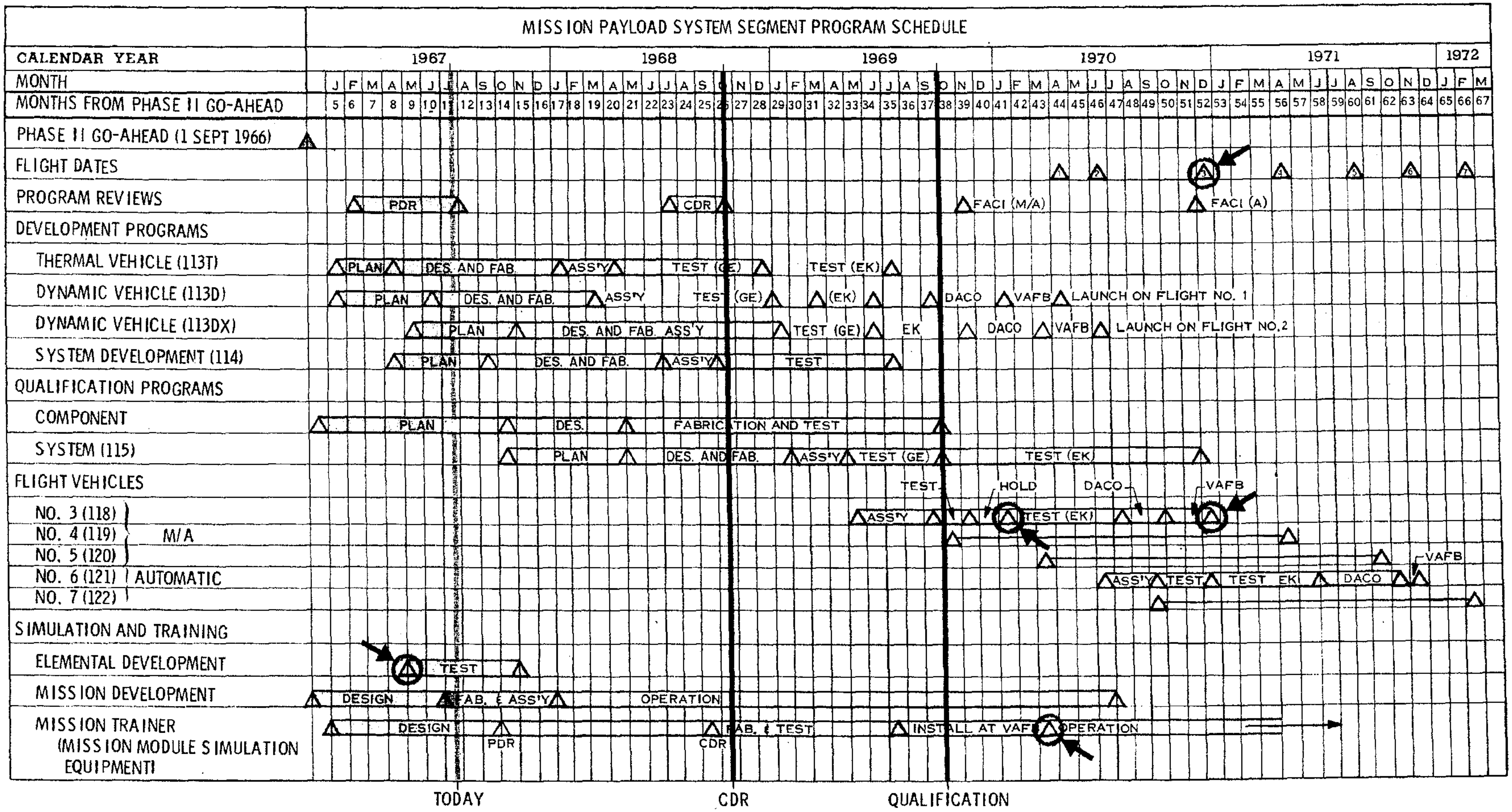
SCHEDULE

POINT TO BE MADE

GE is committed to meet this schedule and can do so.

- First manned flight December 1970
- Program is on schedule
- Sufficient time to integrate with associate contractors and work out detail interfaces
- Schedule has been thoroughly discussed and "shaken out" with the Air Force

MISSION PAYLOAD SYSTEM SEGMENT PROGRAM SCHEDULE



65

GE-MOL FUNDING PLAN

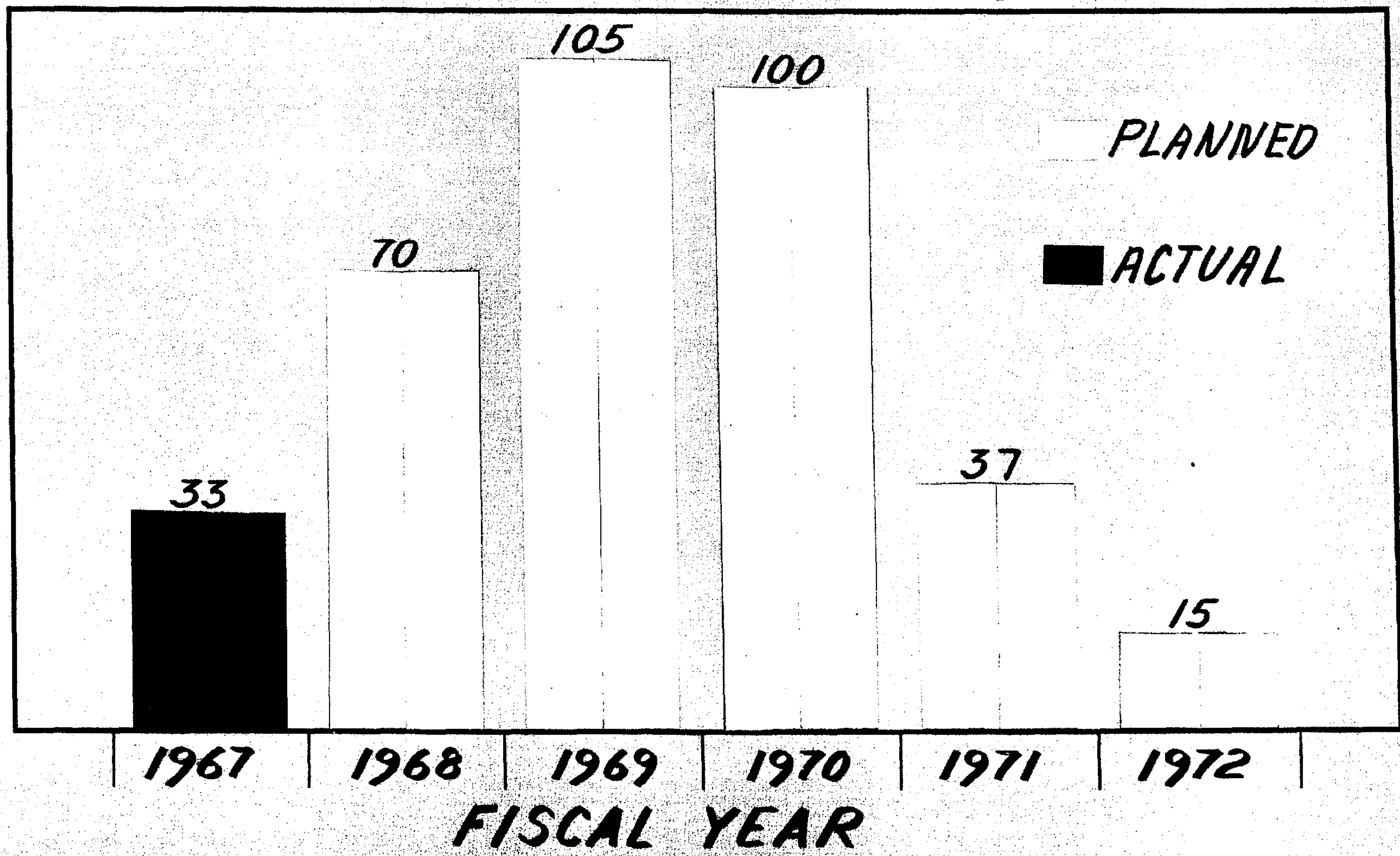
POINT TO BE MADE

This is the GE plan and requirement and has been presented to the Air Force.

- **Total represents what GE can do the job for.**
- **Adjustments among fiscal years may be required to match the schedule.**
- **50% still to be negotiated.**

[redacted]

(DOLLARS IN MILLIONS)



MOL GE TOTAL FUNDING CHART

POINT TO BE MADE

Funding is tight due to detailed tough negotiations but GE is convinced the job can be done for the dollars.

- Substantial portion is subcontracted outside of General Electric for components where competence and experience resides

Star Trackers	-	Kollsman
Gimbal Structure	-	[redacted]
Image Velocity Sensor	-	Itek or Goodyear (Air Force development programs at present)
Accelerometer	-	Bell
Computers	-	IBM
Gyros	-	Honeywell
MDAU	-	Raytheon

- Equal amount (66.1M) is subcontracted to other GE Departments

Apollo Support Dept.	-	49.3M for Test and Checkout Equipment based on Apollo Program Equipment
Reentry Systems Dept.	-	8.4M for Data Recovery Vehicles
Spacecraft Dept.	-	8.4M for N and C and Systems Testing of GE portion of Mission Module

- Additional 25 million dollars will be spent for outside purchases of materials and parts and standard components which require no design and development.

MANNED ORBITING LABORATORY

GENERAL ELECTRIC TOTAL FUNDING

. TOTAL PROGRAM	360 MILLION DOLLARS
. OUTSIDE CONTRACTORS	70 MILLION DOLLARS

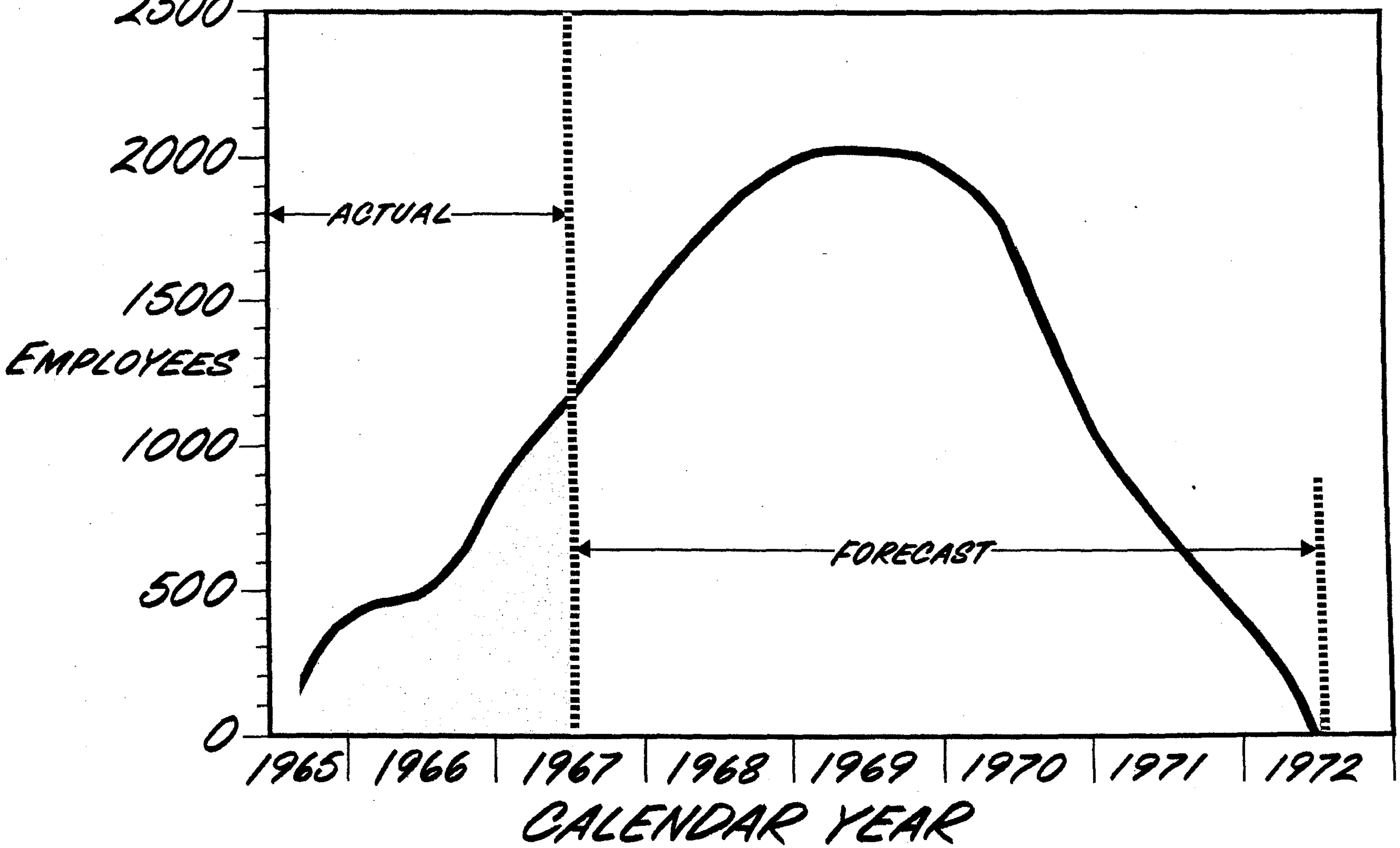
GE-MOL MANPOWER PLAN

POINT TO BE MADE

Buildup has been generally according to plan and since contract negotiations have been completed requirements are being met.

- Major perturbations in past (first half of 1966) have interrupted manpower buildup
  - Phase 1B and 1C
  - Alternate studies start and stop
    - Dump truck
    - Orbiting control module (OCM)
    - AFSCM 375 in, out, back in
- Security was a problem, but will not be in forseeable future.
- Plan will be met if no further perturbations occur.

GE-MOL PROGRAM MANPOWER PLAN



GE-MOL MAJOR SUBCONTRACTORS

POINT TO BE MADE

Experienced contractors for all key components have been selected and are working on the program.

- **Itek and Goodyear (asterisked) are on direct contract to the Air Force as competitors for the preliminary design and development of the Image Velocity Sensor.**

GE - MOL MAJOR SUBCONTRACTORS

SUBCONTRACTOR	COMPONENT	RELATED EXPERIENCE
• KOLLSMAN	• STAR TRACKER	• ORBITING ASTROMICAL OBSERVATORY
• HONEYWELL	• RATE GYROS	• MANY CLASSIFIED AIR FORCE PROGRAMS
• RAYTHEON	• MISSION DATA ADAPTER UNIT	• SPARROW, OTHER AIR FORCE PROGRAMS
• ITEK	• ACQUISITION AND TRACKING SCOPE	• SPECIALISTS IN OPTICS AND OPTICAL SYSTEMS
• MCDONNELL	• GIMBAL STRUCTURE	• MERCURY, GEMINI, MANY AIRCRAFT PROGRAMS LARGE BERYLLIUM STRUCTURES FABRICATION
• GE-RE-ENTRY SYSTEMS DEPARTMENT	• DATA RECOVERY VEHICLE	• MARK 2, MARK 6, MARK 12, DISCOVERER, BIOSATELLITE
• GE-SPACECRAFT DEPARTMENT	• CONTROLS ELECTRONICS	• NIMBUS ORBITING ASTRONOMICAL OBSERVATORY
• GE-APOLLO SUPPORT DEPARTMENT	• GROUND TEST AND CHECKOUT EQUIPMENT	• APOLLO CHECKOUT EQUIPMENT FOR ENTIRE FLIGHT VEHICLE
• ITEK* • GOODYEAR*	• IMAGE VELOCITY SENSOR	• INFRARED SENSORS, VIDICONS, AND OTHER ELECTRO-OPTICAL EQUIPMENT FOR SPACE PROGRAMS

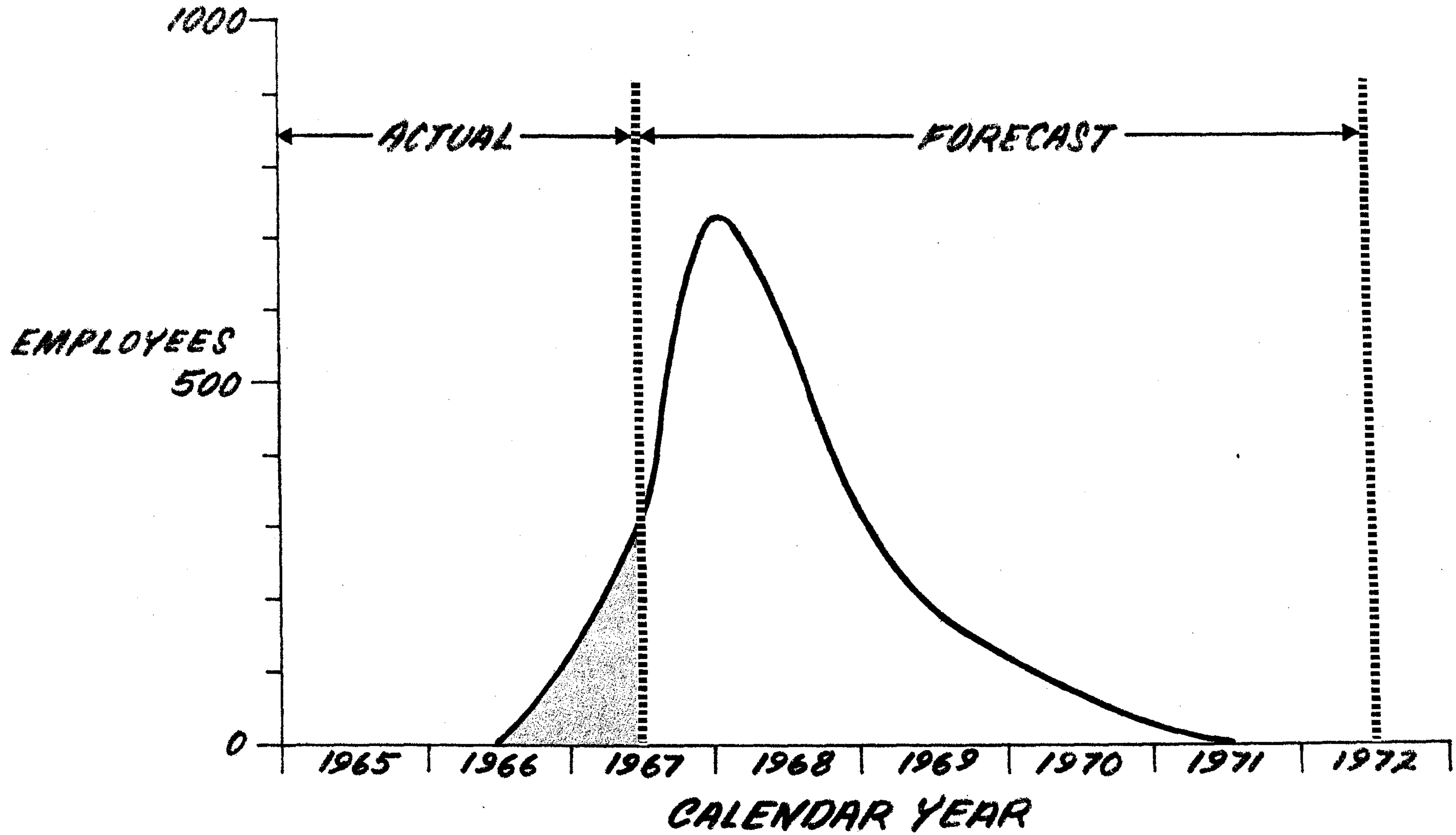
8

GE-MOL SUBCONTRACTOR MANPOWER PLAN

POINT TO BE MADE

Requirements are being met.

GE-MOL SUBCONTRACTOR MANPOWER PLAN



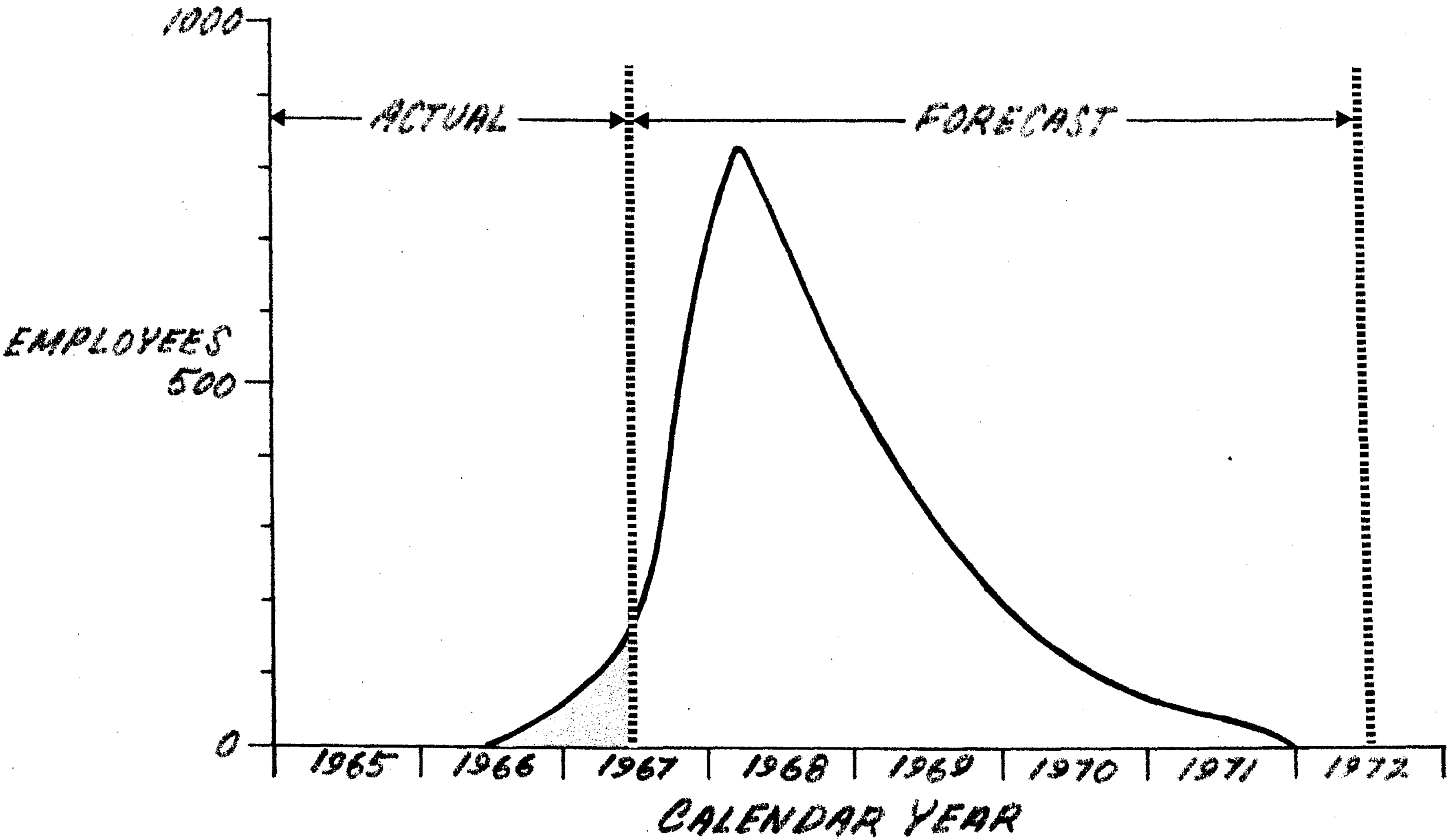
85

MOL - OTHER GE DEPARTMENTS MANPOWER PLAN

POINT TO BE MADE

Requirements are being met

MOL-OTHER GE DEPARTMENTS MANPOWER PLAN



89

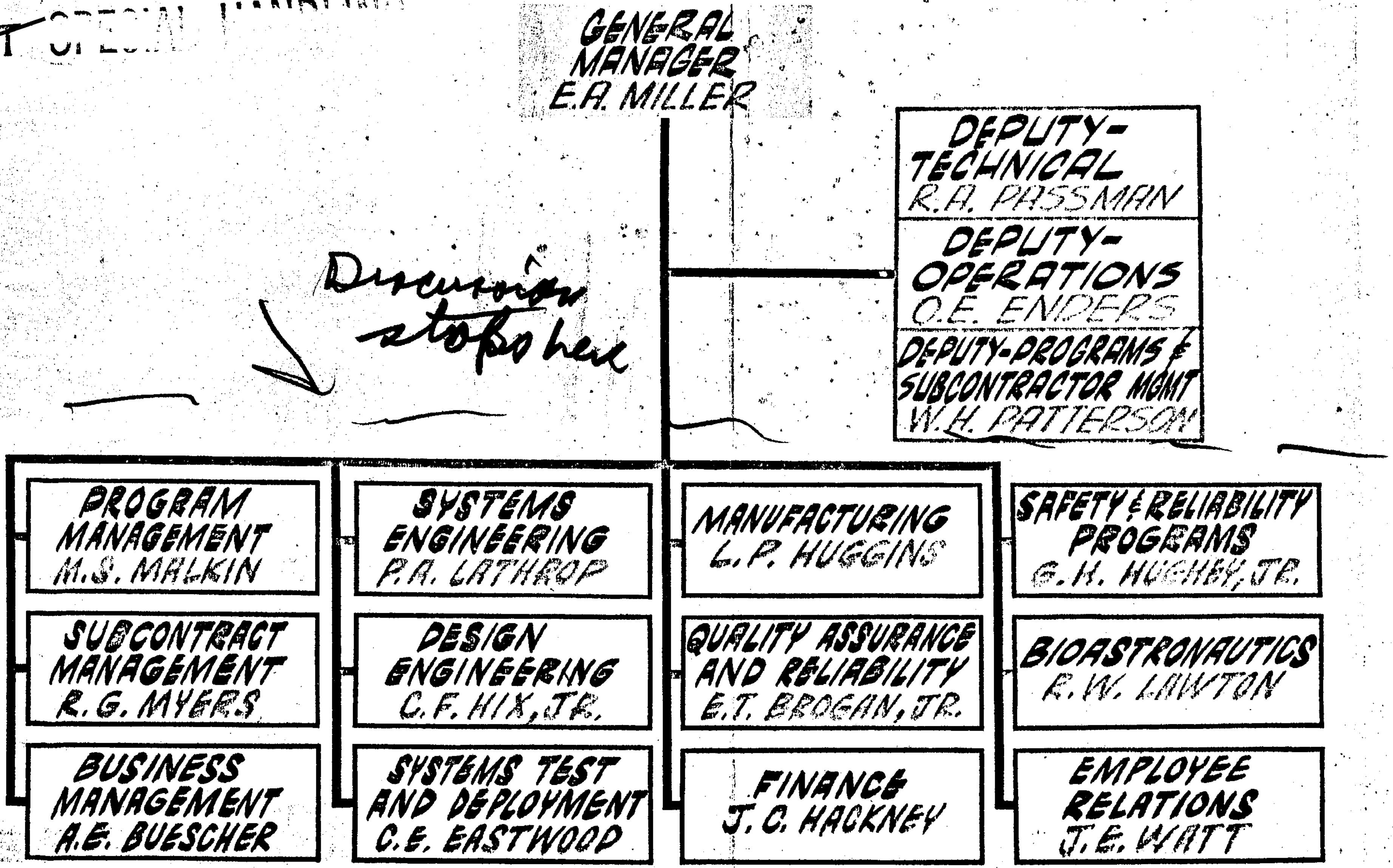
MOL DEPARTMENT ORGANIZATION CHART

POINT TO BE MADE

Confirm H. W. Paige's statement that vertical project organization will perform the job; key people all experienced in Air Force military space programs.

- Program Management to define and keep up to date on commitments, prepare and maintain schedules and budgets, define tasks to be performed, and measure performance against commitments
- Engineering to design and develop hardware and software
  - Systems
  - Design
  - System Test and Deployment
- Manufacturing, Quality Assurance to provide required hardware
- Safety and Reliability Programs to assure that all aspects of program will yield safe operation and reliable performance

MOL PROGRAM


GENERAL MANAGER
E.A. MILLER
DEPUTY-TECHNICAL
R.A. PASSMAN
DEPUTY-OPERATIONS
O.E. ENDERS
DEPUTY-PROGRAMS & SUBCONTRACTOR MGMT
W.H. PATTERSON
Discussion stops here
PROGRAM MANAGEMENT
M.S. MALKIN
SUBCONTRACT MANAGEMENT
R.G. MYERS
BUSINESS MANAGEMENT
A.E. BUESCHER
SYSTEMS ENGINEERING
P.A. LATHROP
DESIGN ENGINEERING
C.F. HIX, JR.
SYSTEMS TEST AND DEPLOYMENT
C.E. EASTWOOD
MANUFACTURING
L.P. HUGGINS
QUALITY ASSURANCE AND RELIABILITY
E.T. BROGAN, JR.
FINANCE
J.C. HACKNEY
SAFETY & RELIABILITY PROGRAMS
G.H. HUGHEY, JR.
BIOASTRONAUTICS
R.W. LAWTON
EMPLOYEE RELATIONS
J.E. WATT

50

GE-MOL INTERNAL CONTROL

POINT TO BE MADE

All elements and procedures necessary for timely identification of problems and assignment of responsibility for their solution are in place and being met.

- Section responsibilities clearly defined, including assignment of responsibilities down to individual contributors.
- Measures of performance, such as detailed description of expected results and their schedule, correlated budget plans negotiated and agreed to with the sections.
- Air Force Cost Planning and Control System on contract for reporting of status and prediction of trends.
- Scheduled reviews with higher management to assure compliance with contract
  - technical
  - schedule
  - cost
- Audits by competent individuals from other departments periodically made to check up. Examples:
  1. Proposal reviewed to assure correct and reasonable correlation between work to be performed, schedule and cost by comparison with other programs.
  2. Safety audit performed to review preliminary design and operations plans to assure that personnel safety (in-orbit and on-ground) have been adequately considered.
  3. Design reviews - The design of the gimbal bearings and their performance and duty cycle requirements have been thoroughly reviewed by experts within GE and from other companies (SKF for example).
- MOL Program Manager "walks the shop" to check up at individual contributor level on progress in solving key problems and to assess program status.

GE - MOL INTERNAL CONTROL

- VERTICAL PROJECT ORGANIZATION
- ORGANIZED BY ELEMENTS OF WORK TO BE ACCOMPLISHED
- TECHNICAL AND DESIGN REVIEWS
- COST PLANNING AND CONTROL SYSTEM
- PROGRAM REVIEW MEETINGS
- PROGRAM ANALYSIS AND REVIEW WITH VICE-PRESIDENT
- PROGRAM AUDITS BY GROUPS FROM OTHER DEPARTMENTS

SUBCONTRACT CONTROL, EXTERNAL TO GE

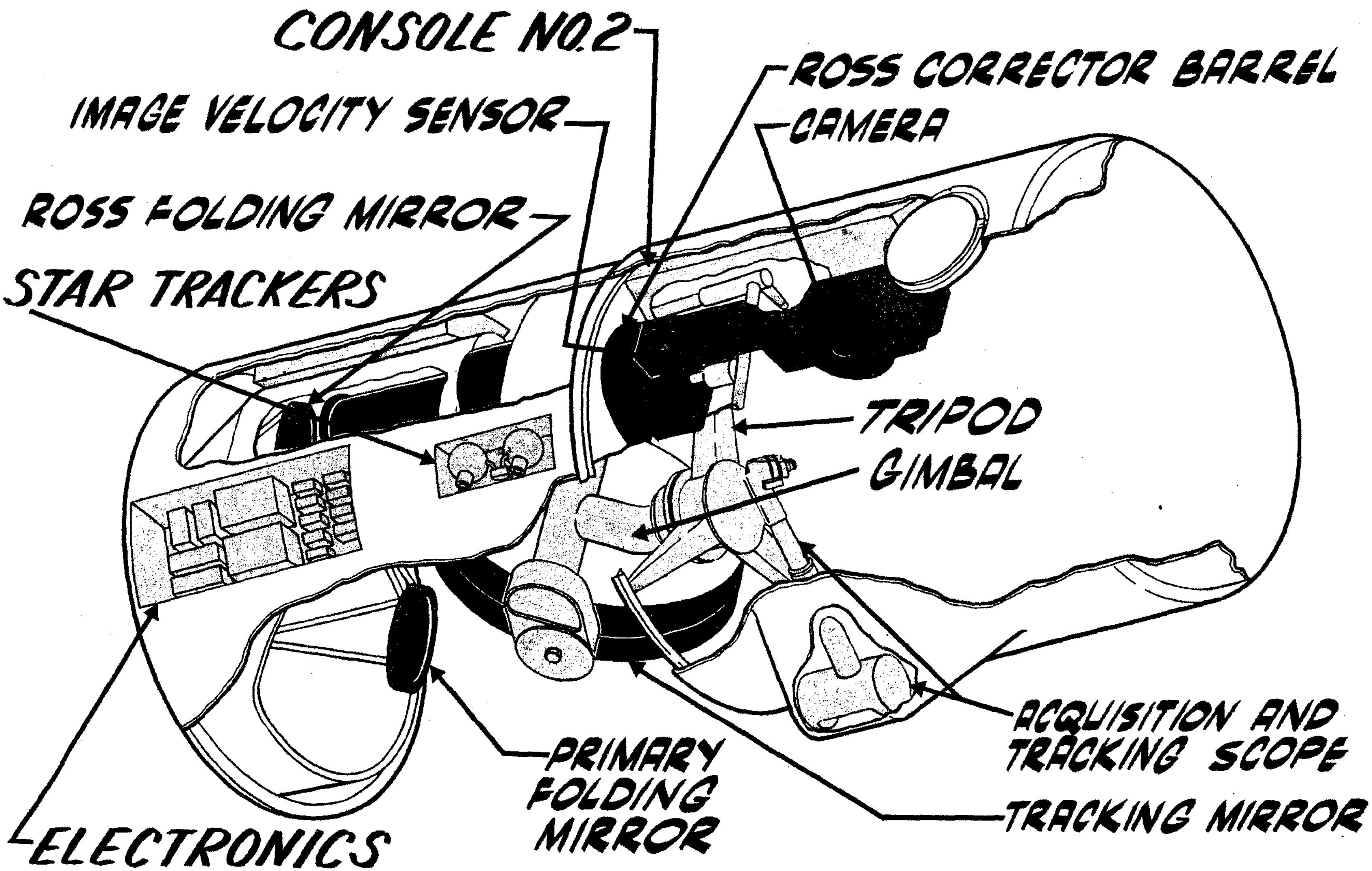
POINT TO BE MADE

GE manages the subcontractors the way the Air Force manages GE.

- Subcontract Management Section has an individual assigned full time for each major subcontractor.
- Supported by a team from Engineering, Manufacturing, and Quality Assurance and Reliability to participate in monitoring progress, assessing problems and assuring their solution.
- Air Force Systems Project Office invited to participate in technical meetings.

SUBCONTRACT CONTROL, EXTERNAL TO GE

- MANAGED BY SECTION REPORTING DIRECTLY TO MOL PROGRAM MANAGER
- NEGOTIATED CONTRACT
- MONTHLY FORMAL MEETINGS
- INFORMAL MEETINGS
- REPORTS


CONSOLE NO.2
ROSS CORRECTOR BARREL
IMAGE VELOCITY SENSOR
CAMERA
ROSS FOLDING MIRROR
STAR TRACKERS
TRIPOD
GIMBAL
ACQUISITION AND
TRACKING SCOPE
PRIMARY
FOLDING
MIRROR
TRACKING MIRROR
ELECTRONICS

105

SUMMARY AND CONCLUSIONS

- [redacted] RESOLUTION [redacted]
- TECHNOLOGIES REQUIRED ARE ADAPTIONS OF THOSE SUCCESSFULLY DEMONSTRATED ON OTHER PROGRAMS
- UTILIZATION OF MAN ON EARLY FLIGHTS WILL SHORTEN DEVELOPMENT CYCLE AND WILL SIMULTANEOUSLY INSURE OBTAINING HIGH QUALITY PHOTOGRAPHS ON THESE FLIGHTS
- PROGRAM CAN BE SUCCESSFULLY ACCOMPLISHED WITHIN SCHEDULE AND TOTAL PROGRAM FUNDING

SIMULATOR	OBJECTIVES
• BASIC DESIGN DEVELOPMENT (BREADBOARD)	DEFINE BASIC PROBLEMS AND DEVELOP DESIGN CONCEPTS FOR MANNED AND UNMANNED MODES
LEADS TO ↓	
• MISSION DEVELOPMENT	FOR MANNED AND UNMANNED MODES • DEVELOP MISSION OPERATION REQUIREMENTS • DEFINE TRAINER DESIGN REQUIREMENTS • DEVELOP ON-BOARD COMPUTER SOFTWARE
LEADS TO ↓	
• TRAINER	SERVE AS MISSION TRAINER FOR AEROSPACE PILOTS BE INCORPORATED INTO OVERALL FLIGHT VEHICLE SIMULATOR
STIMULUS MATERIALS GENERATOR	• PROVIDE TARGETS FOR SIMULATORS • TEST THE IMAGE VELOCITY SENSOR INCLUDING ON-BOARD COMPUTER

SIMULATOR OBJECTIVES

POINT TO BE MADE

Simulator and associated equipment required to develop both the unmanned automatic configuration and the manned configuration.

NOTE TO EAM: Ed Merrick will describe the operation of the EDS and SMG and, if required, Dr. Scoles will operate the EDS for demonstration purposes.

Acquisition and Tracking Scope (ATS) mockup in the area is semi-functional. It is designed for maximum magnification (127) and can be zoomed down to 63.5 (2:1 zoom). The folding lens system is then inserted into the optical path to reduce the magnification range from 15.88 to 31.76 via the zoom.

The external parts of the ATS are similar to the main optics tracking mirror in that it is gimballed, requires bearings, drives, gyros and electronics.

The computer, using stored programs, operates each of the two scopes independently to observe alternate targets. If desired, the pilot can slave the main tracking mirror to one of the ATS via the computer and thus manually control the main tracking mirror.

109

SIMULATION AREA

TEST RESULTS TO DATE

- DRIVE MOTORS SIZES SELECTED
- RATE GYROS SELECTED
- RATE ACCURACY TOLERANCE ALLOCATIONS ESTABLISHED
  - GYROS
  - BEARINGS
  - DRIVE MOTORS
  - ELECTRONICS
- MEASUREMENT TECHNIQUES VERIFIED

TEST RESULTS TO DATE

POINT TO BE MADE

Significant results have been achieved to date but more testing is required to attain all the objectives.

Note to EAM: Stu Hobbs will expound in more detail especially quantitative results, using brush recorder data mounted on the wall.

GIMBAL DRIVE REQUIREMENTS

- MOVE 1400 POUND MIRROR ASSEMBLY AT
- ANGULAR EXCURSIONS
- SLEW TIME, MAXIMUM EXCURSION
- TRACKING RATE ACCURACY
- POINTING ACCURACY

[redacted]

GIMBAL DRIVE REQUIREMENTS

POINT TO BE MADE

Quantitative requirements have been defined as a result of detailed systems analysis and design feasibility studies.

- Tracking rates controlled to a rate equal to 1/6 the angular rate of the hour hand of a watch.
- During tracking, mirror rates vary [redacted]

Test will determine how smoothly these variations can be accomplished, especially the transition from a stopped (0 rate) condition to moving.

GIMBAL BRASSBOARD TEST OBJECTIVES

OBTAIN DATA FOR SELECTION AND DETAIL DESIGN OF

- BEARINGS (SIZE, MATERIAL)
- LUBRICANTS
- DRIVE MOTORS
- RATE GYROS
- CONTROL ELECTRONICS
- ON-BOARD COMPUTER PROGRAM EQUATIONS

NAVIGATION AND CONTROL BRASSBOARD AREA

~~SECRET~~ SPECIAL HANDLING

GIMBAL BRASSBOARD TEST OBJECTIVES

POINT TO BE MADE

Test objectives are well defined.

195

LOC-00029-87

RPT DATA ENTERED
DATE 08/19/87
☑ MICROFICHED
DATE 9/30/87

MEETINGS AND BRIEFINGS RETIRED FILE

NO.	NO.	DATE	SUBJECT
1.	68308-69	13 May 69	MOL Policy Committee Meeting - 9 May 69
1A.	89624-69	~~8~~ 15 Apr 69	Briefing to Dr. McLucas by Gen Bleymaier of 8 APR 69
2.	68354-69	11 Feb 69	Brief - MOL & VHR Issues Given DepSecDef
3.	21307-67	14 Sep 67	Report of 14 Sep DORIAN Brief for Sec of Def
4.	50196-67	9 Aug 67	VIP Presentation
5.	21383-67	Undtd	General Stewart's Presentation
6.	21218-67	Jul 67	Minutes, Jul 7 Internal Management Meeting
7.	21171-67	12 Jun 67	DORIAN Status Briefing to Dr. Hornig
8.	21138-67	14 Apr 67	Minutes, 14 Apr 67 MOL Management Meeting
9.	21384-67	14 Mar 67	Meeting on MOL Revised Costs/Schedules
10.	21009-67	16 Jan 67	5 Jan 67 MOL Management Meeting
11.	Uncl	9 Jan 67	Action Items fr Last MOL Program Review
12.	CH 4206	9 Jan 67	Guidance/Decisions fr MOL Management Meeting
13.	21310-66	17 Aug 66	Briefing to PSAC on MOL
14.	WH 5507	21 Jul 66	Proposed Agenda for PSAC
15.	67170-66	7 Jun 66	Wholly Unmanned System Briefing
16.	21132-66	13 May 66	EKC Visit on 17 May w/66692-66 Ser A cy 2
17.	21099-66	13 Apr 66	PRC, MOL Systems Office, Apr 2, 66
18.	21092-66	5 Apr 66	PRC, MOL Systems Office, 2 Apr 66
~~19.~~	UNCL	Undtd	AF MOL Policy Committee Agenda Item-1st Meeting 2-25-65, W/CONF ATCHMT.
20.	65-0910-A2	2 Mar 65	MOL Policy Committee Meeting
21.	36687-65	6 Jan 65	Meeting with Dr. McMillan on MOL, W/O ATCH.
22	68303-69	UNDTD	DORIAN INDOCTRINATION