Surveyor Project Status Report

As of 5 February 1965

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FOREWORD

The biweekly Surveyor Project Status Report presents, in one document, a summary of schedule, manpower, and cost status information for the Surveyor Project and its associated systems.

All schedule information is correlated and reviewed by the Project Office on a biweekly basis. Cost and manpower information is correlated from monthly financial reports maintained by the Jet Propulsion Laboratory.

Jet Propulsion Laboratory
California Institute of Technology

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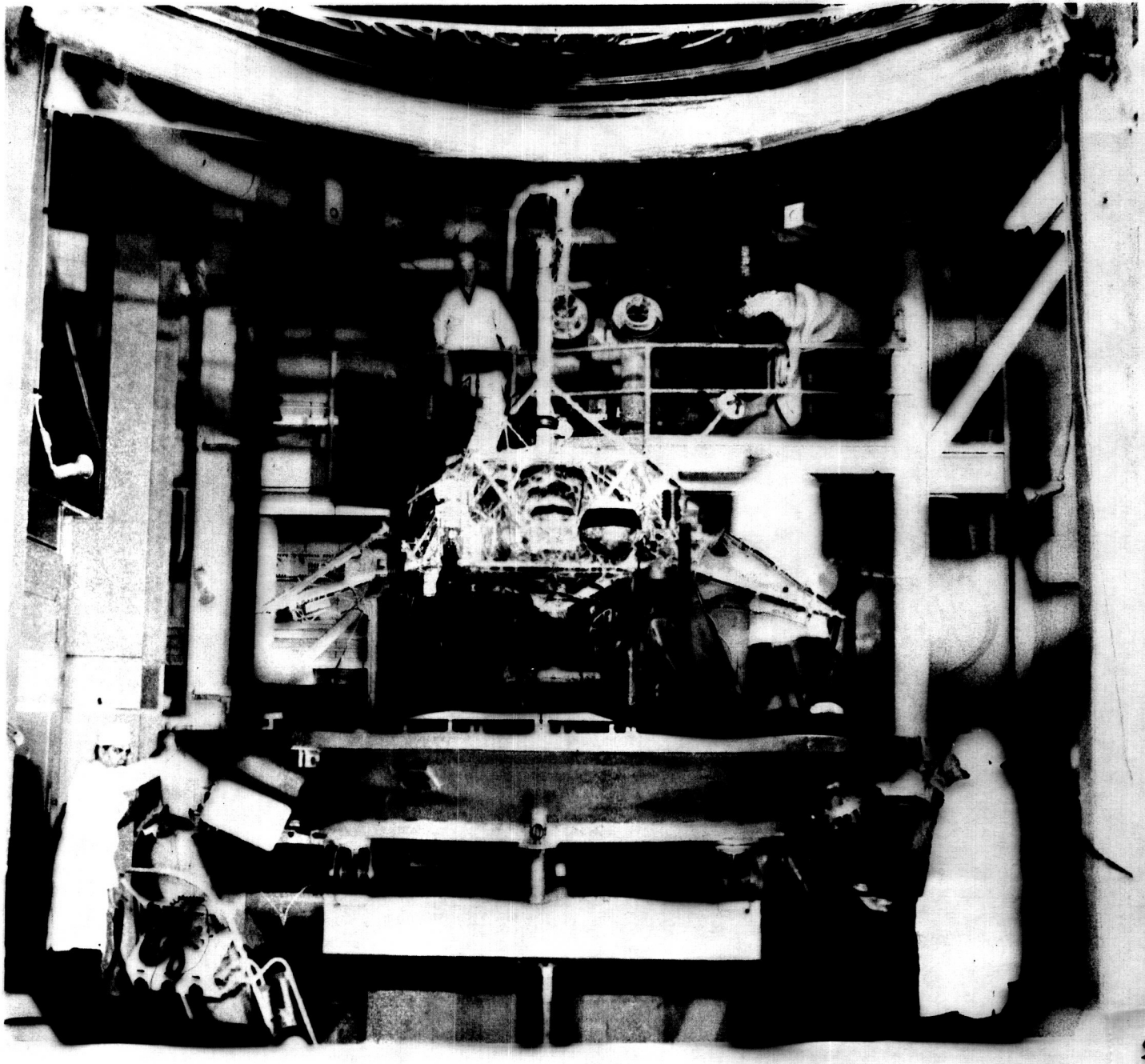
ELEVATION OF END BELL WITH T-21 INTO CHAMBER.



PROJECT SUMMARY

Current Events

1.0 T-21 Proof Test Model

Pump-down for STV on T-21 occurred on January 28, two days late. Tests had to be suspended when the Flight Control System overheated. About eight hours of testing was completed at the time of the failure. The Flight Control System was removed and checked to determine the failure mode. The problem was later diagnosed as a Scott T transformer circuitry problem. Induced self-oscillations dissipated energy in the compnents on the terminal board at an excessive rate. STV testing resumed and abort was experienced on 5 February because of a problem with the Flight Control Sensor Group. Resumption of STV testing is expected by 10 February with completion planned by 15 February.

2.0 SC-1 Flight Spacecraft

Systems group tests have been in process and are scheduled for completion by 19 February. The Flight Control Group tests are nearing completion and the telecommunications integration tests are about 50% complete. The RADVS group tests have started. A problem of broken jackscrews on spacecraft harness connectors caused tolerance variations and incorrect thread calibration. Careful mating of each connector is planned to eliminate the problem.

3.0 SC-2 Flight Spacecraft

System group tests are in process and will continue until 12 March 1965. TV testing is about 50% completed with satisfactory results on more than 80% of the data analyzed. RF testing is scheduled to begin next week.

4.0 Dynamic Models SD-1

The SD-1 dynamic model with transponder was checked out at AFETR and completed encapsulation on 3 February 1965. Quadtanking and plugs out testing will be performed on Atlas/Centaur L/U. The S/C(SD-1) will then be demated, flight hardware installed, remated and all tests completed by March 2, 1965.

5.0 Terminal Descent Test Program

A. Vehicle Design. The Recovery Electronics Assembly (REA) is being modified to improve the emergency firing procedure and reduce weight. Fabrication of REA units has stopped pending completion of mods. Fabrication has started on the Telemetetry and Command Assemblies. The Schematic and ABM for the Klystron Power Supply Modulator were completed and signed off. A method has been devised for increasing the allowable vehicle weight by reducing the amount of thrust per engine for attitude control. This has proven to be feasible with but minor modification. The preliminary insulation thermal testing for RADVS was completed, the results are currently being evaluated, and a decision is expected shortly.

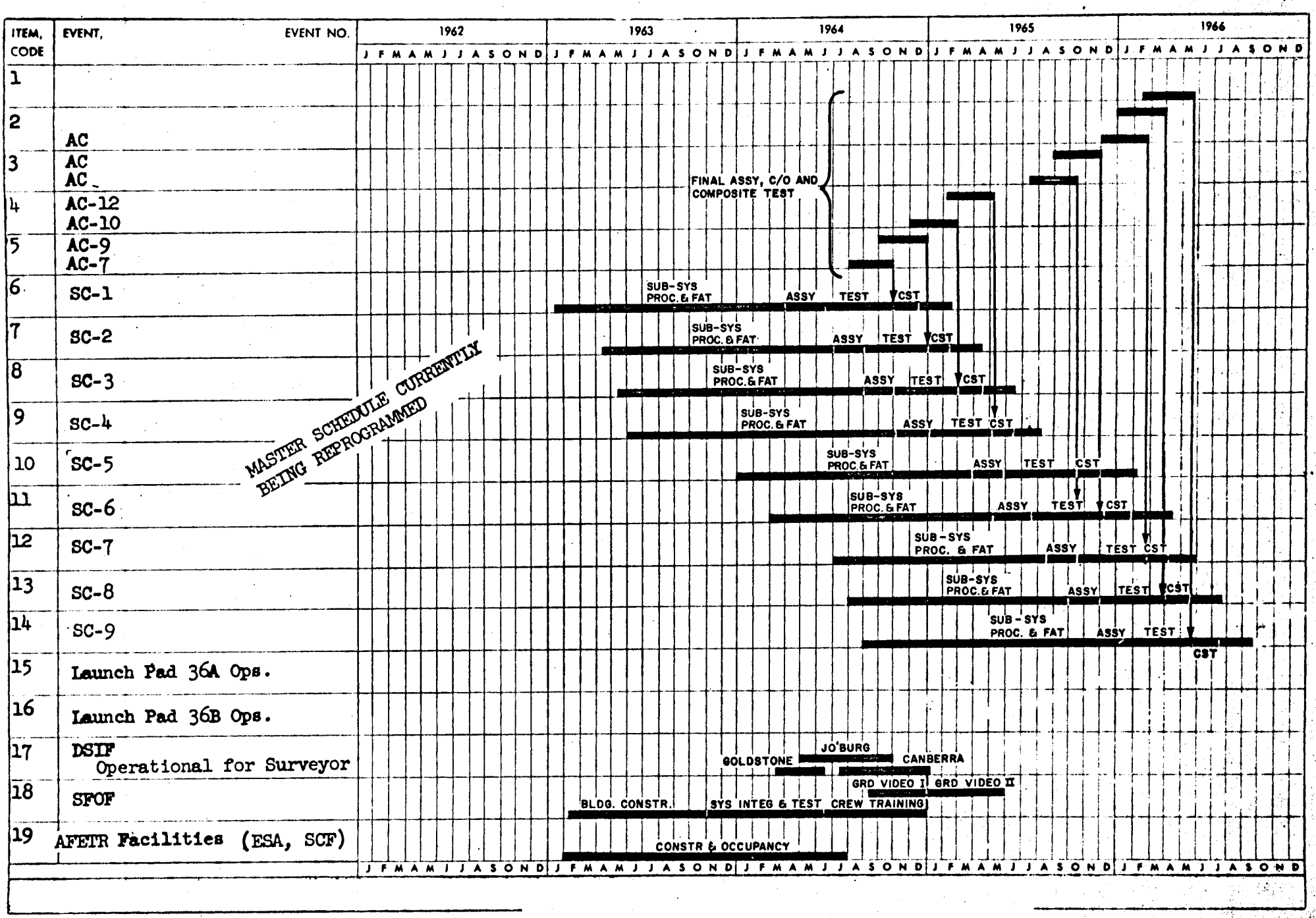
B. Range Documentation and Facilities. The Planning Estimate and the Operations Requirements portion of the National Range Document has been sent to the White Sands Missile Range. An Engineering Service Plan is currently being prepared for the Holloman Air Force Base Range Directorate. The 500-foot radius circle and access roads on the new site have been graded and compacted. Power poles and transformers have been delivered and are being installed. Plumbing for the buildings has been roughed in and concrete poured Optical camera pads are being surveyed in by Land-Air Inc.

6.0 S-2A Structural Test Vehicle

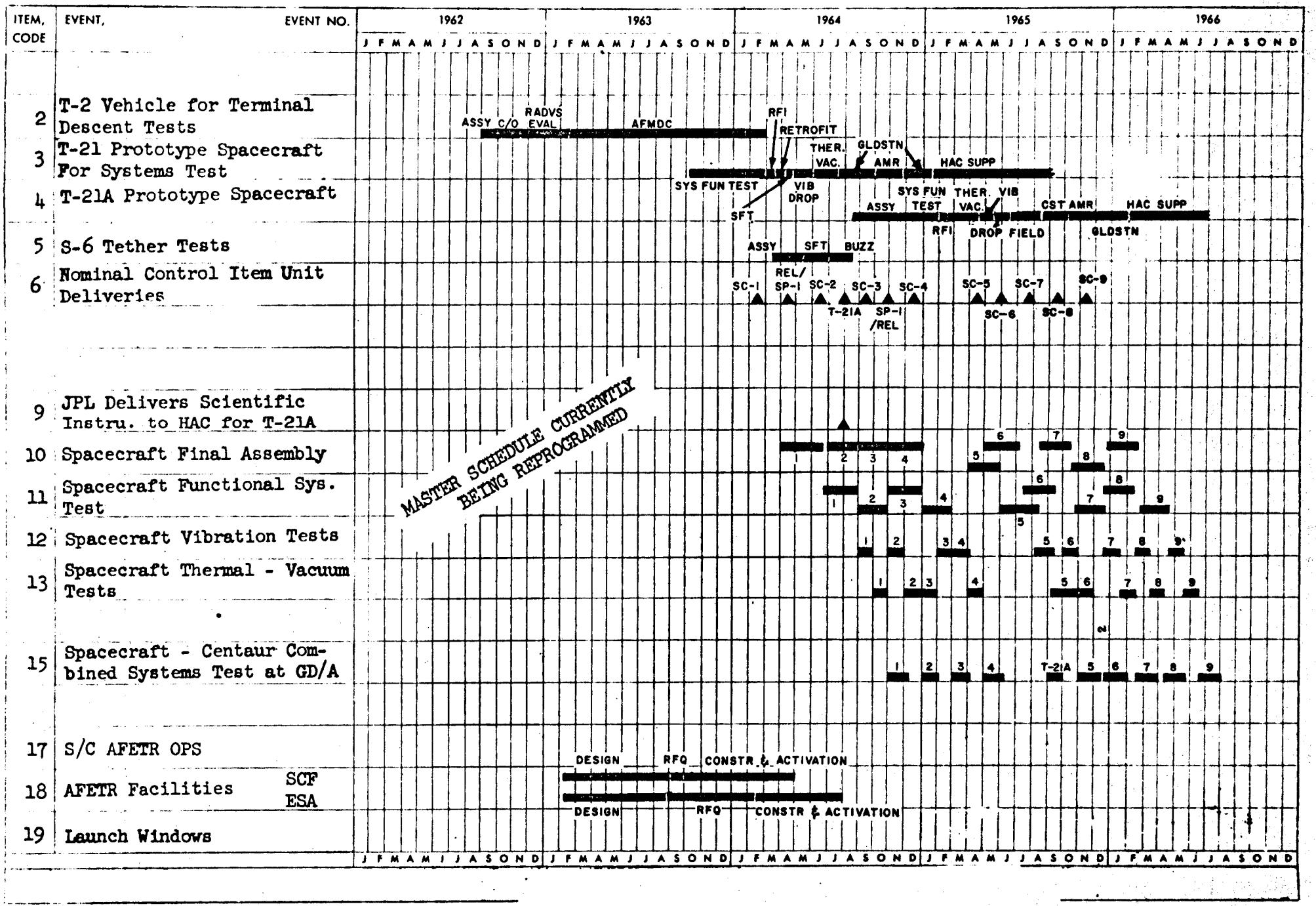
The variable frequency vibration tests were performed (with the planar antenna at 87°) to evaluate the response of the Flight Control Sensor Group. Work continues on checking the orthogonality of the vibration modal survey test data. The first group of data indicated acceptable orthogonality properties. During the next reporting period, several tests are to be conducted.

Continued on page 16

Project Master Schedule

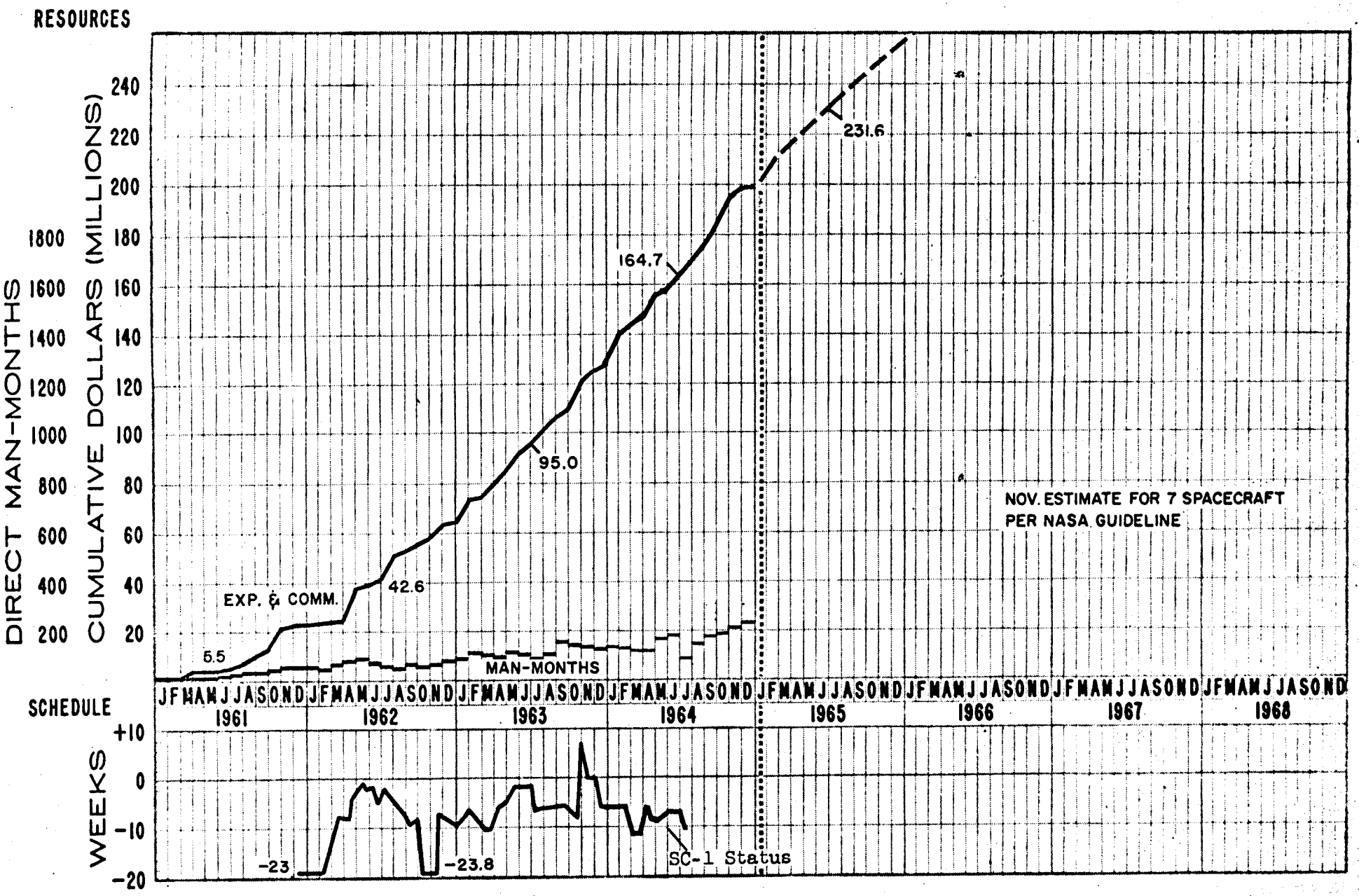


Spacecraft Master Schedule



Surveyor Project Status Report AS OF:
ACTIVITY: PROJECT 22 January 1965

STATUS SUMMARY



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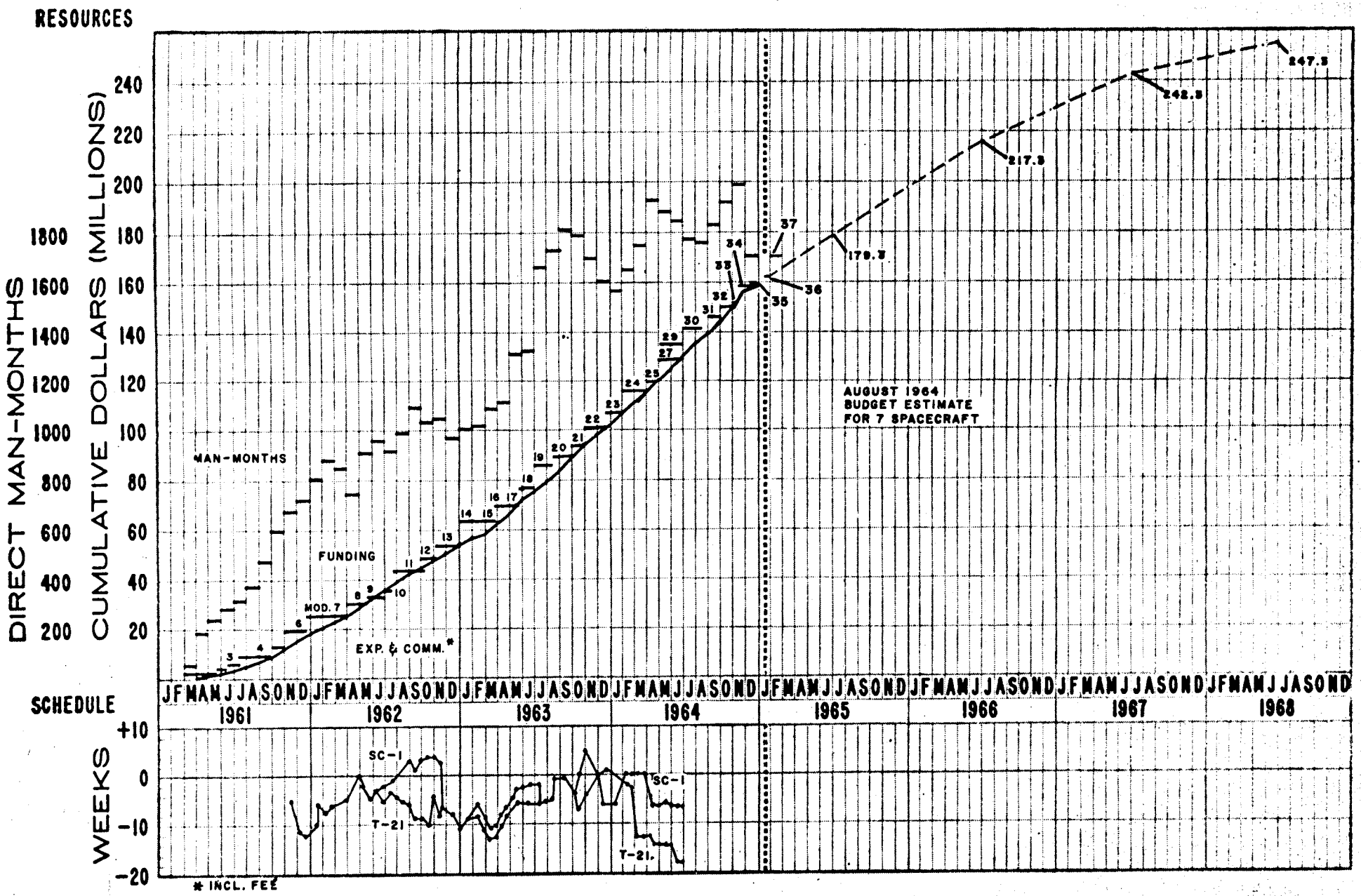
Surveyor Project Status Report AS OF: 5 February 1965 STATUS SUMMARY

ACTIVITY: SPACECRAFT SYSTEM



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SCHEDULED INTERFACE EVENTS CHART DESCRIPTION

The Scheduled Interface Events Chart lists currently planned dates for completion of events of primary importance to timely accomplishment of Surveyor missions. These events will normally involve action by two or more Surveyor System Managers. The following information is presented:

Primary Action

The primary action column indicates the organization charged with the responsibility for task performance leading to event completion and is responsible for reporting event status to completion.

Primary Interest

The primary interest column indicates the organization having tasks to perform which are dependent upon the interface event being completed by the organization of primary action.

Event Description

The event description column describes the event to be completed by the organization with primary action responsibility.

Event Number

The event number column references the event as it is portrayed in the Surveyor Project PERT Network.

Date Originated

The date originated column indicates the date the interface event schedule was established. A numerical suffix code provides a reference to the source from which the schedule was obtained. A reference code index will be maintained by the Surveyor Project Office for this purpose.

Date Scheduled

The date scheduled column indicates the schedule date for completion of the event described.

The Selected Event Chart portrays the current development program and status of systems and subsystems, and are changed only when the plans they are depicting are changed. The bar charts do not show all dependencies which exist on the Surveyor Project Summary PERT Network (e.g. facility availability, test equipment, etc.). However, the PERT symbols do represent status with respect to all constraints shown on the network.

The PERT information gives status relative to the completion of the planned activities (bars) by showing

1) when the activity is expected to be completed (≙);
2) the latest allowable completion date (△) which will enable all succeeding activities to be accomplished without affecting schedule;
3) the completion of activities (▲);
4) the scheduled completion of activities (*);
5) major constraints between systems (↑).

SCHEDULED INTERFACE EVENTS

Primary Action	Primary Interest	Event Description	Event Number	Date Originated	Date Scheduled
HAC	GD/A	Compl Del SD-1 to GD/A			
HAC	GD/A	Compl Del SD-2 to GD/A			
HAC	DSIF	Compl Del CDC to Goldstone			
HAC	DSIF	Compl Del T-21 to Goldstone			
JPL	HAC	Compl Del T-21A Scientific Instruments to HAC			
HAC	GD/A	Compl Del T-21 to AFETR			
HAC	DSIF	Compl Del CDC to Joburg			
GD/A	HAC	Compl CST Facility			
HAC	GD/A	Compl Del SC-1 to GD/A for CST			
HAC	DSIF	Compl Del CDC to Canberra			
GD/A	HAC	Compl AC-7 Prep for CST			
HAC	DSIF	Compl Del T-21 to Goldstone			
JPL	HAC	Compl SC/DSIF/SFOF Compatibility Test at Joburg (Bl.2)			
HAC	GD/A	Compl Del SC-1 to AFETR			
JPL	HAC	Compl SC/DSIF/SFOF Compatibility Test at Canberra (Item V-C, SFOS Sched.)			
JPL	HAC	Compl T-21/DSIF/SFOF Compatibility Test at Goldstone (Item V-E, SFOS Sched.)			
JPL	SFOF	Compl Operational Readiness Tests (Item V-D, SFOS Sched.)			

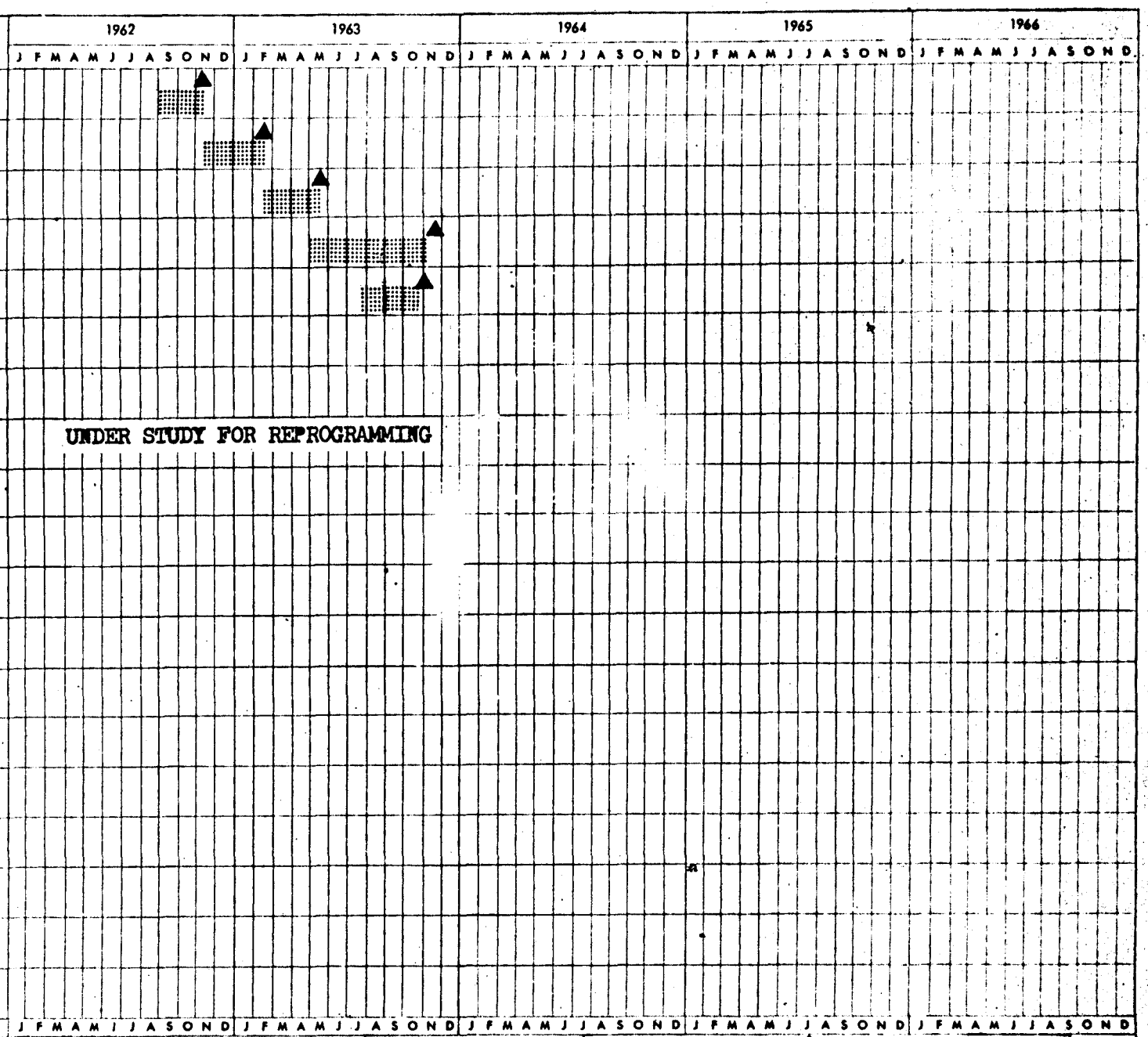
CURRENTLY BEING REPROGRAMED

Surveyor Project Status Report AS OF:

ACTIVITY: T-2, S-8

SELECTED EVENTS

ITEM, CODE	EVENT	EVENT NO.
1	T-2 Assembly & Checkout	
2	T-2 AFMDC Testing (preliminary)	
3	RADVS Rework (prior to T-2H tests)	
4	T-2H Tests & Evaluation	9417068
5	T-2 Tether Tests	9432082
6	T-2 Terminal Descent Tests	9424084
8	S-8 Upgrade	
9	S-8 Tether Tests-Test Equipment Checkout	
10	S-8 Tether Tests	



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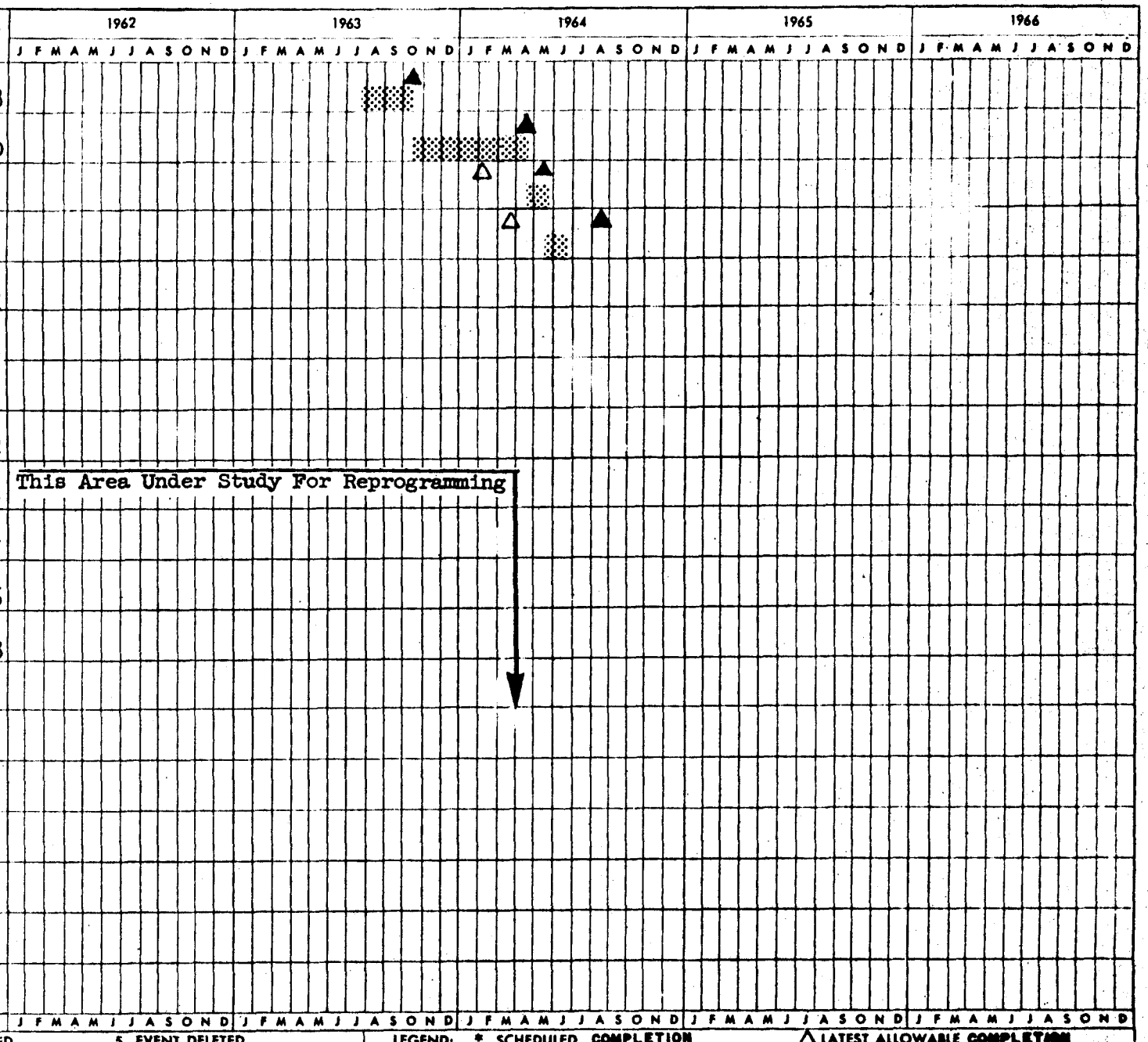
LEGEND: * SCHEDULED COMPLETION; EXPECTED COMPLETION; LATEST ALLOWABLE COMPLETION; ACTUAL COMPLETION

Surveyor Project Status Report AS OF

ACTIVITY: T-21

SELECTED EVENTS

ITEM, CODE	EVENT,	EVENT NO.
1	T-21 Assy (Flight Quality Hardware)	9015088
2	T-21 Sys Functional Test	9017090
3	T-21 Upgrade	9900041
4	T-21 Mission Sequence & RFI Tests	9900043
5	T-21 Compartment Upgrade & Ckout	9900049
6	T-21 VIB Test	9021002
7	T-21 Drop Test	9023002
8	T-21 Thermal/Vacuum Test	9025002
9	T-21 Shipment & Checkout at Goldstone	9025004
10	T-21/DSIF/CDC Goldstone Test	0400037
11	T-21 AGE Proofing Operations	0200026
12	T-21/SLOF/DSIF Goldstone Test	0400043
13	T-21 Engineering Proof Test Support	



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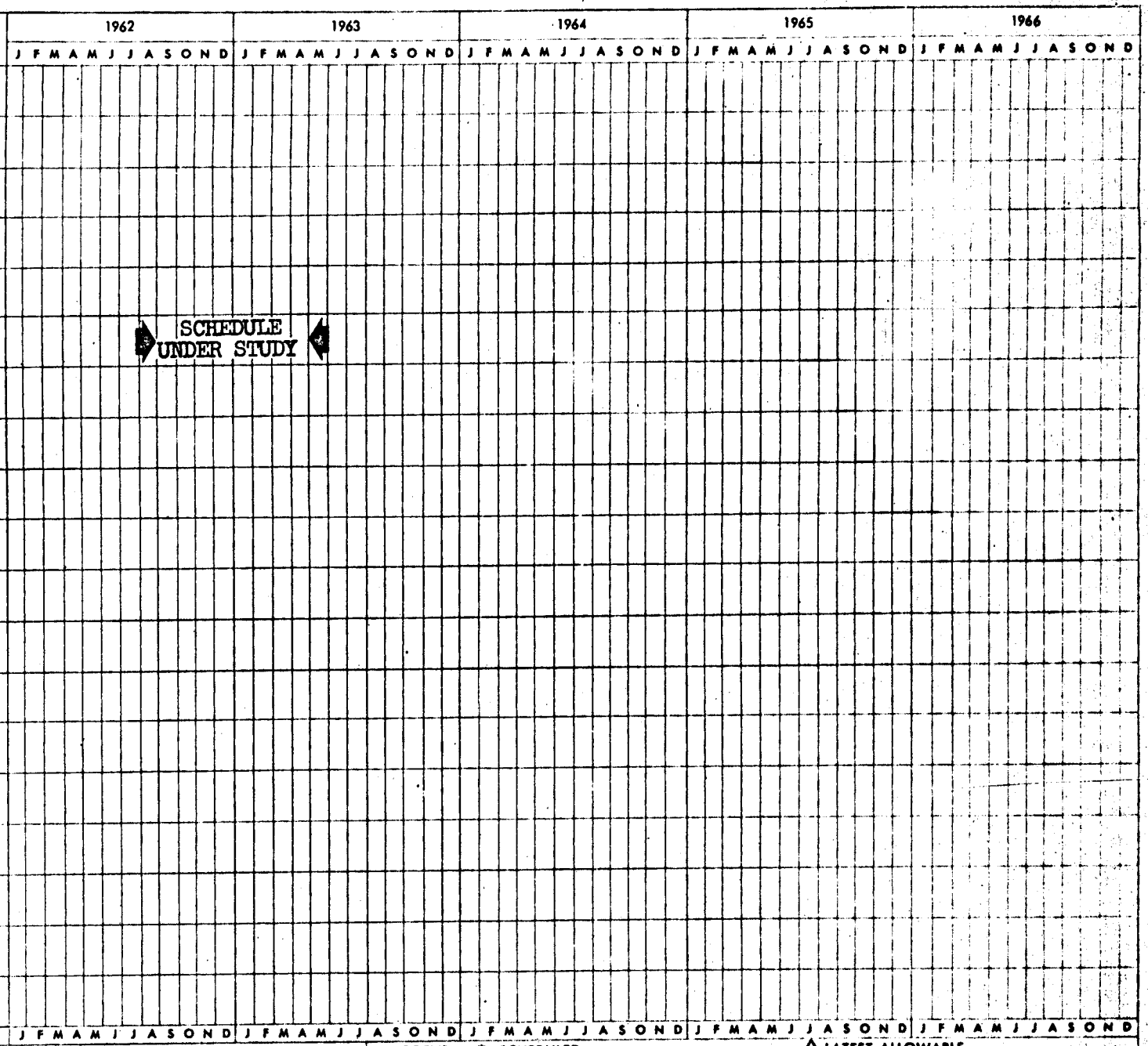
LEGEND: * SCHEDULED COMPLETION; EXPECTED COMPLETION; △ LATEST ALLOWABLE COMPLETION; ▲ ACTUAL COMPLETION

Surveyor Project Status Report AS OF:

ACTIVITY: T-21A

SELECTED EVENTS

ITEM, CODE	EVENT, EVENT NO.
1	T-21A Assembly
2	T-21A System Functional Test
3	T-21A RFI Test
4	T-21A VIB Test
5	T-21A Drop Test
6	T-21A Thermal/Vacuum Test
7	T-21A Combined System Test
8	T-21A AFETR Test
9	T-21A Goldstone Test
10	T-21A HAC Support



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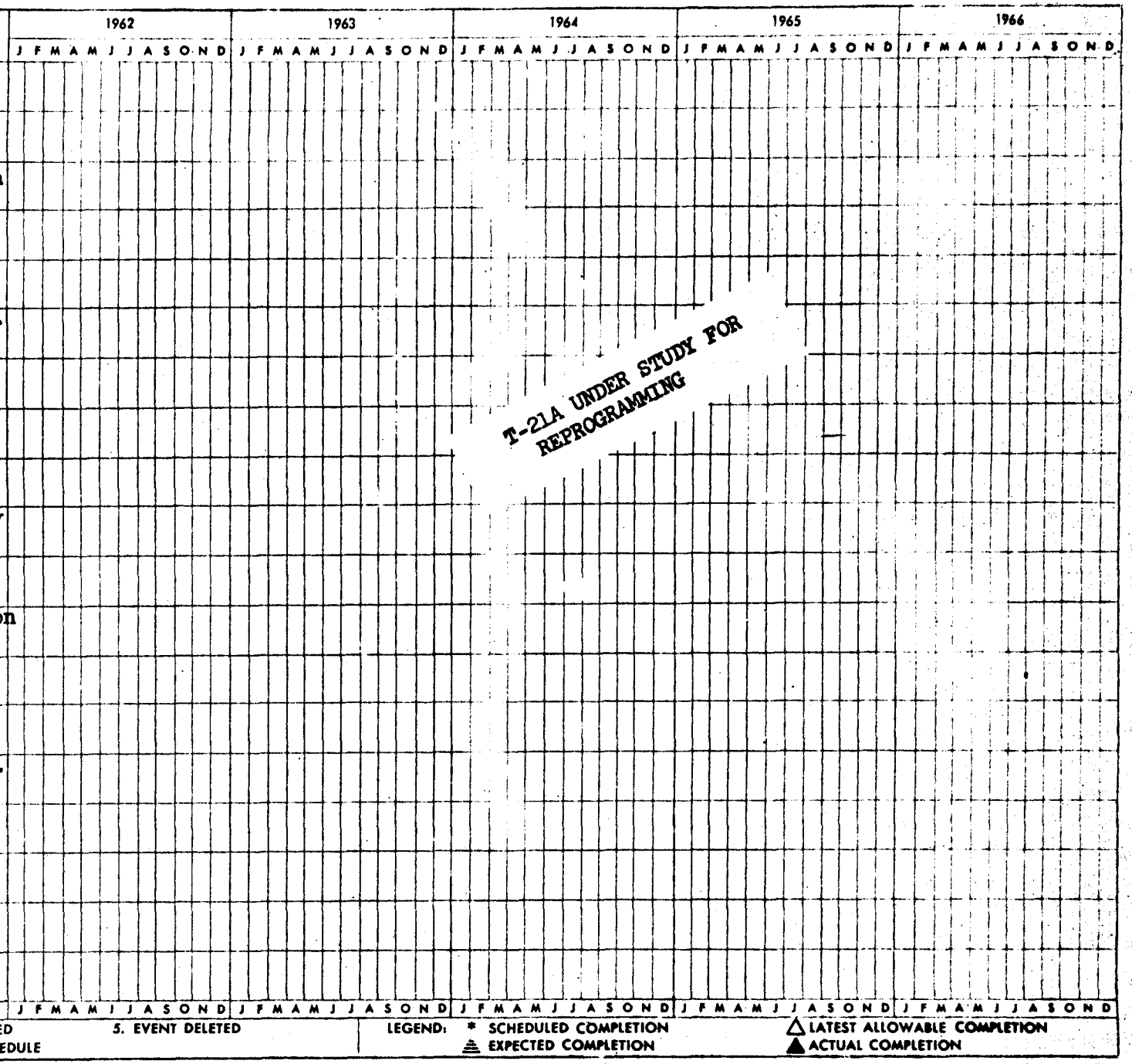
LEGEND: * SCHEDULED ▲ EXPECTED △ LATEST ALLOWABLE ▲ ACTUAL COMPLETION

Surveyor Project Status Report AS OF:

ACTIVITY: Scientific Payload T-21A

SELECTED EVENTS

ITEM, CODE	EVENT, EVENT NO.
1 2	Surface Sampler Fab & Assy
2 2	Surface Sampler FAT
3 4	Surface Sampler Integration & Test
4	Micrometeorite Ejecta Fab & Assy
5 2	Micrometeorite Ejecta FAT
6 4	Micrometeorite Ejecta Integration & Test
7 2	Seismometer Fab & Assy
8 2	Seismometer FAT
9 4	Seismometer Integration & Test
10	Alpha Scattering Fab & Assy
11	Alpha Scattering FAT
12 4	Alpha Scattering Integration & Test
13	Touchdown Dynamics Fab & Assy
14	Touchdown Dynamics FAT
15 4	Touchdown Dynamics Integration & Test
16	T.V. 2 & 3 Fab & Assy
17	T.V. 2 & 3 FAT
18	Scientific Instrument Aux Fab & Assy
19	Scientific Instrument Aux FAT



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LEGEND: * SCHEDULED COMPLETION; EXPECTED COMPLETION; LATEST ALLOWABLE COMPLETION; ACTUAL COMPLETION

Surveyor Project Status Report AS OF: —

ACTIVITY: MISSION A

SELECTED EVENTS

ITEM, CODE	EVENT,	EVENT NO.
1	SC-1 Assembly	9107150
2	SC-1 System Funct & RFI Tests	9109152
3	SC-1 Therm/Vacuum Test	9207002
4	SC-1 Vib Test + Del to GD/A	9111154
5	SC-1 and AC-7 Combined Sys Test	9115158
6	SC-1 Readiness Testing	0500001
8	AC-7 Final Assy, c/o, + Composite Test	0200000
9	CST Facility Activation (Operational)	
10	STEA 2 Install + c/o at GD/A	
11	Launch Pad Availability	0500018

CODE: 1. NEW EVENT 2. CHANGE IN DATA 3. EVENT COMPLETED 4. CHANGE IN SCHEDULE 5. EVENT DELETED

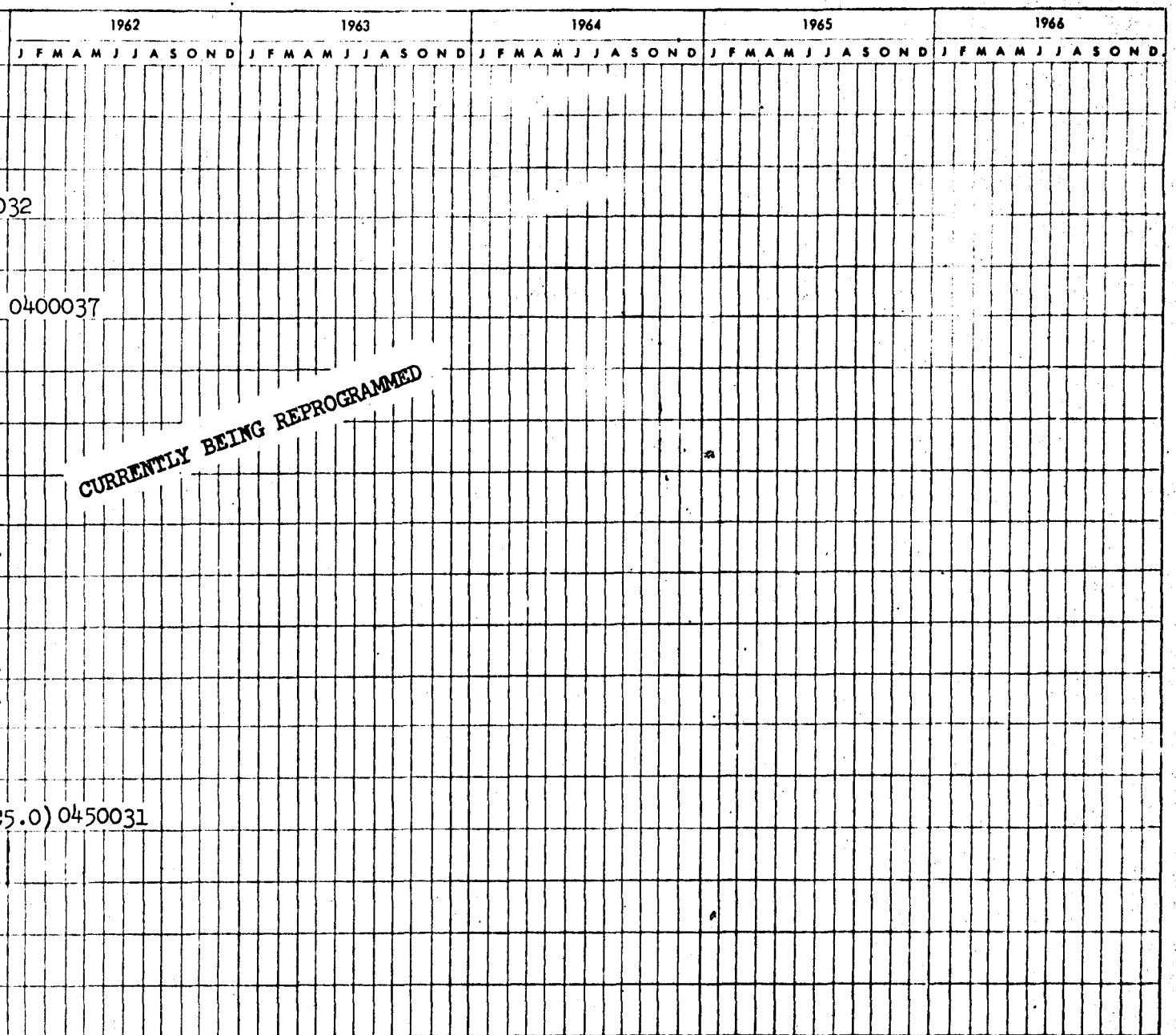
LEGEND: * SCHEDULED COMPLETION; EXPECTED COMPLETION; LATEST ALLOWABLE COMPLETION; ACTUAL COMPLETION

Surveyor Project Status Report AS OF:

ACTIVITY: DSIF/SFOF

SELECTED EVENTS

ITEM, CODE	EVENT,	EVENT NO.
1	Goldstone Facility Rdy for CDC Instl.	
2	CDC Instl. Ckout Goldstone	0400033
3	S-Band Instl. Compl.- Goldstone Operational	0400032
4	S-Band/CDC Compat Test Goldstone (A1.1)	0400035
5	T-21/DSIF/SFOF Compat. test Goldstone (A1.4,B1.4,C1.0)	0400037
6	Joburg Facility Rdy for CDC Instl.	
7	CDC Instl. Ckout Joburg	0400071
8	S-Band Instl. Compl-Joburg Operational	0400073
9	S-Band/CDC Compat. Test Joburg (A1.2)	0400075
10	SC/DSIF/SFOF Compat. Test Joburg (B1.2)	0400077
11	Canberra Facility Rdy for CDC Instl.	
12	CDC Instl. Ckout Canberra	0400053
13	S-Band Inst Compl.-Canberra Operational	
14	S-Band/CDC Compat. Test Canberra (A1.3)	0400055
15	SFOF/DSIF Operational Readiness Test (C2.0,C4.0,C5.0)	0450031
16		



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PROJECT DEVELOPMENT PLAN SUMMARY *

Surveyor is a lunar soft landing and surface investigation project managed by JPL's Lunar and planetary Project Office for the NASA Headquarters Office of Space Science and Applications. The Project is supported from within NASA by the Lewis Research Center (LeRC) and the Goddard Space Flight Center (GSFC). Within JPL, the cooperation of the Deep Space Network is involved. Hughes Aircraft Company (HAC) is under contract to JPL to develop the spacecraft.

The objective shall be to demonstrate a soft landing on the Moon in 1965 as evidenced by postlanding spacecraft operations in one or more missions. Subsequent to 1965, the primary objective will be to perform lunar surface operations contributing new scientific knowledge about the Moon and providing basic data in support of Project Apollo.

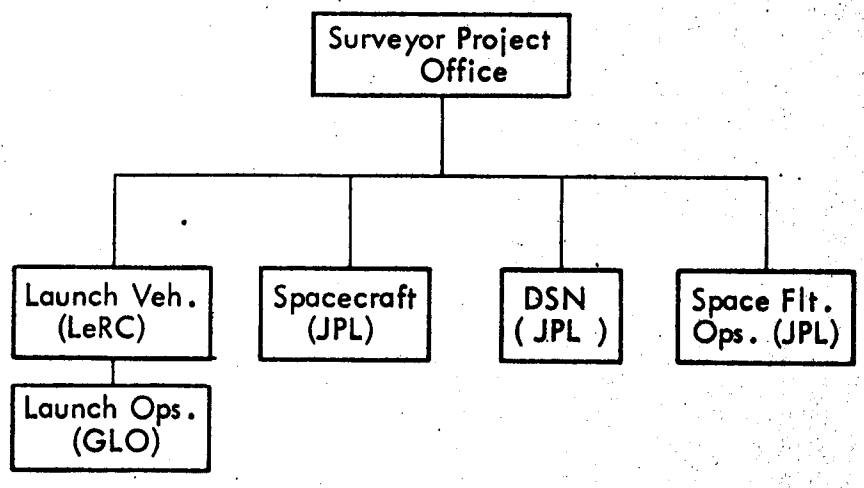
The Surveyor Project Block I currently comprises seven flight missions. These missions will utilize the Atlas/Centaur launch vehicle with launches to be conducted from Complex 36 at the Air Force Eastern Test Range (ETR), Cape Kennedy. The missions will be conducted utilizing direct ascent launch trajectories with a spacecraft having a nominal separated weight of 2150 lbs. The missions will be divided into two groups consisting of (1) four spacecraft designated as engineering test flights and containing an engineering performance payload and (2) three spacecraft designated as operational vehicles which contain a scientific instrument payload.

During transit, the Deep Space Instrumentation Facility will be used for spacecraft orbit determination and to transmit the necessary commands to effect a midcourse maneuver to minimize the lunar landing dispersion. The DSIF will also be used to receive engineering and scientific data telemetered from the spacecraft during transit to and operations on the lunar surface.

After spacecraft injection, all additional mission operations will be conducted from the JPL Space Flight Operations Facility. Accumulation of engineering and scientific data and the processing and partial reduction of the scientific data will be accomplished at this Facility. The SFOF will be the focus of continuing operations associated with the conduct of experiments during the 30 - to 90 day life of the Surveyor spacecraft on the lunar surface.

The scientific payload will consist of the following experiments: television (2 survey cameras), micrometeorite ejecta, seismographic, alpha scattering, surface sampler (for soil mechanics), and touchdown dynamics.

A project organization consisting of four systems has been planned for Surveyor. The four systems and their parent organizations are shown in the accompanying chart.



* Updated abstracts from pre-release PDP dated 28 February 1964.

GLOSSARY

Spacecraft Model Designations

SC-1 through SC-4. Flight-quality, subsystem and system flight-acceptance tested spacecraft carrying the engineering payload and designated for Surveyor test missions.

SC-5 through SC-7. Flight-quality, subsystem and system flight-acceptance test spacecraft carrying the scientific payload and designated for operational missions.

SD-1 through SD-4. Spacecraft dynamic models associated with Centaur R and D flight AC-5 and AC-6 and two Plumbrook tests respectively.

S-2. Test spaceframe for vibration, shock, and static structural tests of the A-21 spacecraft.

S-6, S-7. Test spaceframes for vernier propulsion system prequalification testing.

S-8. Spacecraft for tether tests to determine dynamic compatibility of spaceframe, vernier engine subsystem and flight control subsystem.

T-1. Test spacecraft for simulated lunar landing drop tests (completed) and Centaur separation testing.

T-2. Test spacecraft for descent dynamics testing.

T-2H. Helicopter test vehicle for descent tests of T-2 RADVS.

T-21. Prototype spacecraft having same configuration as SC-1 through SC-4 for system, type-approval, and mission-simulation tests.

T-21A. Prototype spacecraft having same configuration as as SC-5 through SC-7 for system, type-approval, and mission simulation tests.

MT-1. Thermal test spacecraft, constructed in three sectors, comprising together a thermal mockup of spacecraft.

Abbreviations

AC Atlas/Centaur launch vehicle system.

AFETR Air force Eastern Test Range, Cape Kennedy.

CDC Command and data-handling console installed at the DSS.

CST Combined System Test.

DSIF Deep Space Instrumentation Facility.

DSS Deep Space Station of DSIF (located at Krugersdorp, South Africa; Woomera, Australia; and Goldstone, California).

ESA Explosive Safe Area, ETR.

GD/A General Dynamics/Astronautics, Atlas/Centaur vehicle contractor (LeRC contract).

GSE Ground Support Equipment.

HAC Hughes Aircraft Company, Spacecraft System contractor (JPL contract).

LeRC Lewis Research Center, NASA

PDP Surveyor Project Development Plan, dated 28 February 1964.

RADVS Radar Altimeter and Doppler Velocity Sensor.

RMD Reaction Motors Division, Thiokol, vernier engine subcontractor (JPL).

SCF Spacecraft Checkout Facility.

SFOF Space Flight Operations Facility.

SFOP Space Flight Operations Plan.

STEA System Test Equipment Assembly used to perform overall systems test on spacecraft.

STL Space Technology Laboratories, vernier-engine back-up feasibility contractor (JPL subcontract).

PROJECT SUMMARY (CONTINUED)

These are static proof loads and drop tests to checkout drop equipment operation; strain gage requirements test; low level vibration tests.

7.0 Vernier Thrust Chamber Assembly (TCA)
The first flight type pre-qualification TCA was acceptance tested during this report period in preparation for initiation of the formal pre-qualification test program. A series of tests to determine effects on engine performance using Helium saturated propellant was also performed. Testing of the TCA under hard vacuum conditions was completed. The factorial design demonstration of the first flight type pre-qualification TCA will be completed during the next report period.

8.0 Vernier Propulsion Subsystem Test
A. The S-6 test vehicle is currently being upgraded. At the completion of this upgrade the test vehicle will be delivered to the Placerita Canyon Test Site on 15 February 1965 and is to begin a series of system dynamic tests on 23 February 1965. These tests include both cold flow and hot firings for the purpose of proving procedures, check starting transients, check gas permeation through tank bladders, result of varying length storage periods, etc. Also, during this period, Hughes Aircraft is fabricating GSE unique to the S-6 tests consisting of fuel servicing and flush carts and oxidizer servicing and flush carts. The scheduling of the S-6 test effort is currently undergoing revision.
B. The S-7 test vehicle is currently awaiting Class IV vernier hardware before completion of upgrade. Modification of the S-7 test plan is anticipated as a result of S-6 tests outlined above.

9.0 TCM Thermal Control Test Program
The S-8 spaceframe has been completely degreased and returned to the assembly area for substructure buildup. Release of a nearly complete configuration index is expected during the next two weeks. Release of instrumentation cabling drawings to fabrication will begin about 8 February 1965 and fabrication is expected to be complete by 15 March 1965. Inadequacy in the technical detail presented to Hughes Aircraft in the GE facility preparation proposal has delayed initiation of the final negotiations to 11 February 1965. Submittal of the GE proposal covering the TCM testing phase is now expected by 10 February 1965. GE has been informed of those areas in their proposal where technical clarification is required. It is anticipated that complete agreement can be reached during the final negotiation and an advanced authorization will be issued.

10.0 Space Operations
There will be three series of tests running more or less in parallel before the class "B" tests. These are generally identified as the DSIF Mission Independent Tests, the DSIF Mission Dependent Equipment and Interfaces Tests and the SFOF Training Tests. Final tests on the mission dependent operating and interface equipment at the DSIFs will be the A.110 after the appropriate Equipment tests. This will be followed by tests to prove compatibility and operating capability for each DSIF site, including both mission dependent and mission independent equipment. Concurrently, the SFOF will be going through the A.1 and A.2 series tests to verify training and operating capability. This will be followed by the "B" tests for complete compatibility of all areas and equipment (DSIF and SFOF) and finally the "C" tests for demonstrating operational readiness of all elements of space operations including technical and operating personnel. The A-1.2 tests are to ensure that equipment and/or personnel within SFOF have been functionally and operationally integrated and are prepared to participate in intra - and/or interfacility Surveyor SFO tests. In the A-1.2 area of SFOF tests, six of fourteen tests have been completed in FPAC, one of twenty tests has been completed in SPAC, and two of twenty tests have been completed in SSAC. During the testing programs problems have been identified, however the tests have been generally successful. An eight week training program for DSN

PROJECT SUMMARY (CONTINUED)

personnel for the operation and maintenance of the CDC has started. Two personnel are at HAC from Joburg and additional DSN personnel will be arriving within the next two weeks. A modified CDC has been delivered to Goldstone, and modified CDCs for the overseas sites are nearing readiness for shipment.

CRITICAL PATH ANALYSIS

SC-1 Mission A

Completion of systems group testing is approximately 2.0 weeks behind schedule due to expected late delivery of the Omni Antenna Mechanism, Antenna and Solar Panel Positioner and Thermal switches. However, recovery of schedule slippage is expected prior to completion of initial systems checkout 20 March, 1965. Initial systems checkout has started ahead of schedule with those systems that have been delivered. Therefore, delivery of the SC-1 spacecraft from HAC remains on schedule.

T-21 Proof Test Model

Completion of solar vacuum testing is not expected until 15 February 1965, approximately 3.5 weeks behind schedule. Late availability of propellant tanks, roll actuator and the antenna and solar panel positioner also impacts upon the completion of vehicle upgrade which is not expected until 26 February, 1965. The above schedule slippages represent a potential delay in completion of the T-21 test program. However, HAC and JPL are currently reviewing the test plan to determine necessary recovery action.

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