N66-10642
(ACCESSION NUMBER)
21
(PAGES)
CR 67641
(NASA CR OR TMX OR AD NUMBER)
(THRU)
1
(CODE)
31
(CATEGORY)
FACILITY FORM 602

SPSR No. 67

Surveyor Project Status Report

As of 8 January 1965

GPO PRICE $
CFSTI PRICE(S) $
Hard copy (HC) 1.00
Microfiche (MF) .50
ff 653 July 65

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PASADENA, CALIFORNIA

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Surveyor Project Status Report

As of 8 January 1965

Prepared by L. S. Frankenstein
Surveyor Assistant Project Manager

Approved: W. E. Gil on,
Surveyor Project Manager

JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CALIFORNIA

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

Prepared under Contract No. NAS 7-100
National Aeronautics and Space Administration

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SCIENTIFIC INSTRUMENT TESTS IN THE PAYLOAD SYSTEMS LABORATORY AT HUGHES AIRCRAFT COMPANY

PROJECT SUMMARY

Note: Detail planning and schedule integration associated with launch schedules approved by NASA Headquarters TWX 11 December 1964 is currently underway. Until such time as detailed planning is complete, status of the ongoing effort relative to near term objectives will continue to be reported.

Current Events

1.0 T-21 Proof Test Vehicle
The upgrade program preparatory to the start of solar-vacuum testing was completed 28 December, 1964. Final preparations for solar vacuum testing is now underway. The retro motor has been installed, the vernier propulsion system has been filled with referee fluids and the solar vacuum chamber is undergoing calibration. T-21 will be installed on the end bell as of the date of this report, after which, preliminary tests will be conducted prior to vacuum chamber pump down, **est. date 1-18-65.**

2.0 SC-1 Flight Spacecraft
The upgrade of SC-1 was completed 17 December 1964, and the vehicle then underwent weight, balance and alignment verification tests. Systems group tests began 4 January 1965 and is expected to be completed approximately 4 February 1965.

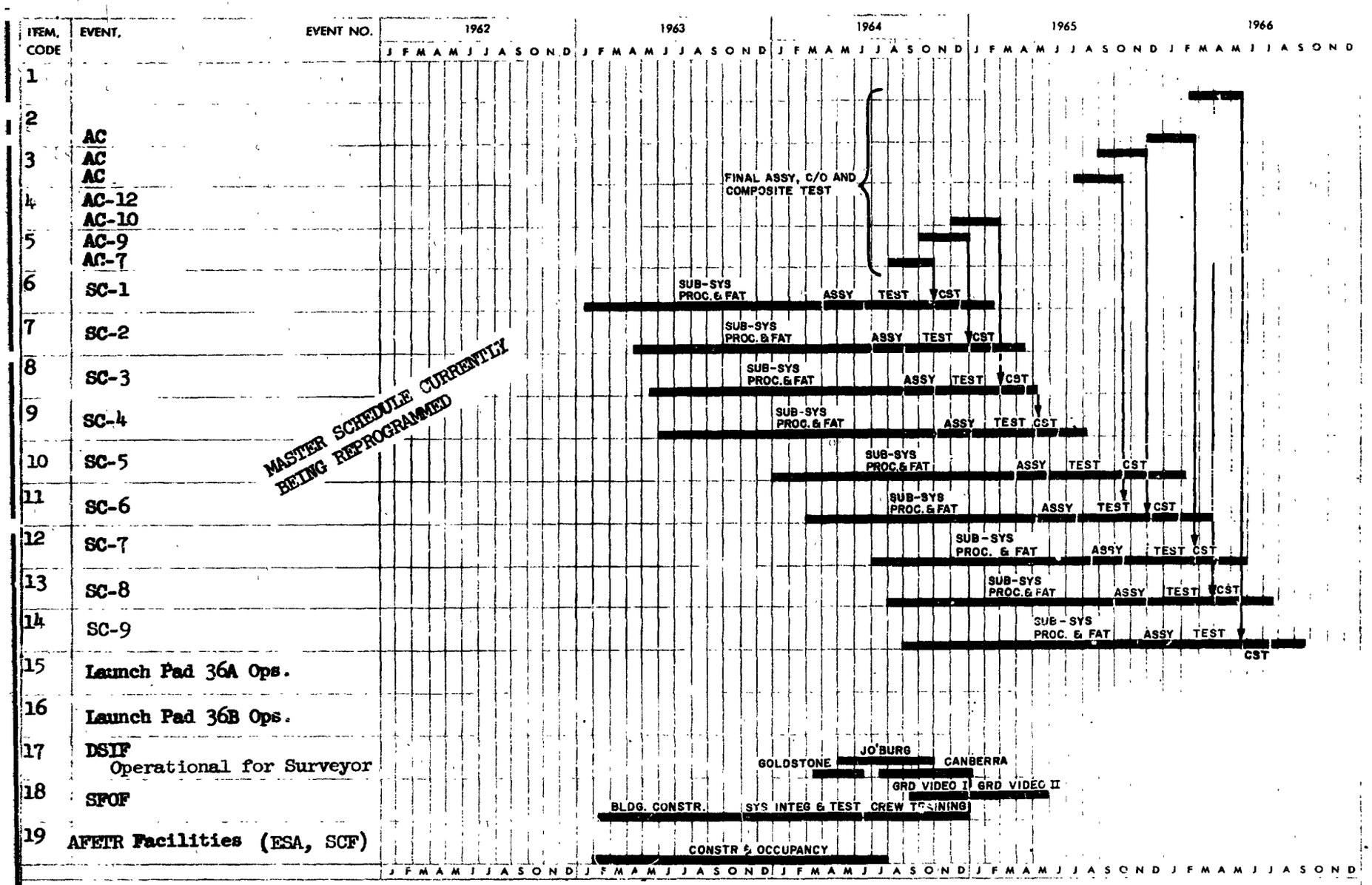
3.0 Terminal Descent Test Program
Hughes Aircraft Company is in the process of preparing a proposal for **the implementing of the terminal descent test program (T-2N) in accordance with the plan described during the Quarterly Project Review on 15-18 December 1964. The schedule date for submission of cost proposal to JPL is 17 January 1965. This proposal will be negotiated as a delta to the mod 28 program currently being negotiated.**

4.0 S-2A Structural Test Vehicle
The S-2A vehicle is currently in the vibration modal survey phase of the test program. The vehicle was set up in the intermediate landing position (solar and planar array at 45° to mast). The rigid body suspension frequencies were determined to be 1.79 cps for the vertical translational mode, .52 cps for the torsional mode about the Z-axis, 3.19 cps for the rocking mode about the X-axis, and 3.04 cps for the rocking mode about the Y-axis. These data will be used to calculate the mass moments of inertia of the spacecraft. Eight modal vibrators are positioned to excite the landing modes of the spacecraft. One exciter is positioned to drive vertically at each crushable block location, and five are suspended horizontal about the antenna and solar panel positioner. A series of eleven frequency sweeps from 4 to 100 cps have been performed to measure response of the spacecraft at the driving points. These sweeps were made at constant driving force level, with individual exciters and selected combinations of exciters in operation. The motion of the driving point was recorded on an X-Y plotter during sweeps. Frequencies at which minimum driving point impedances occurred were noted and tabulated for use in indentifying landing modes. One modal survey at rigid body rocking frequency has been performed.

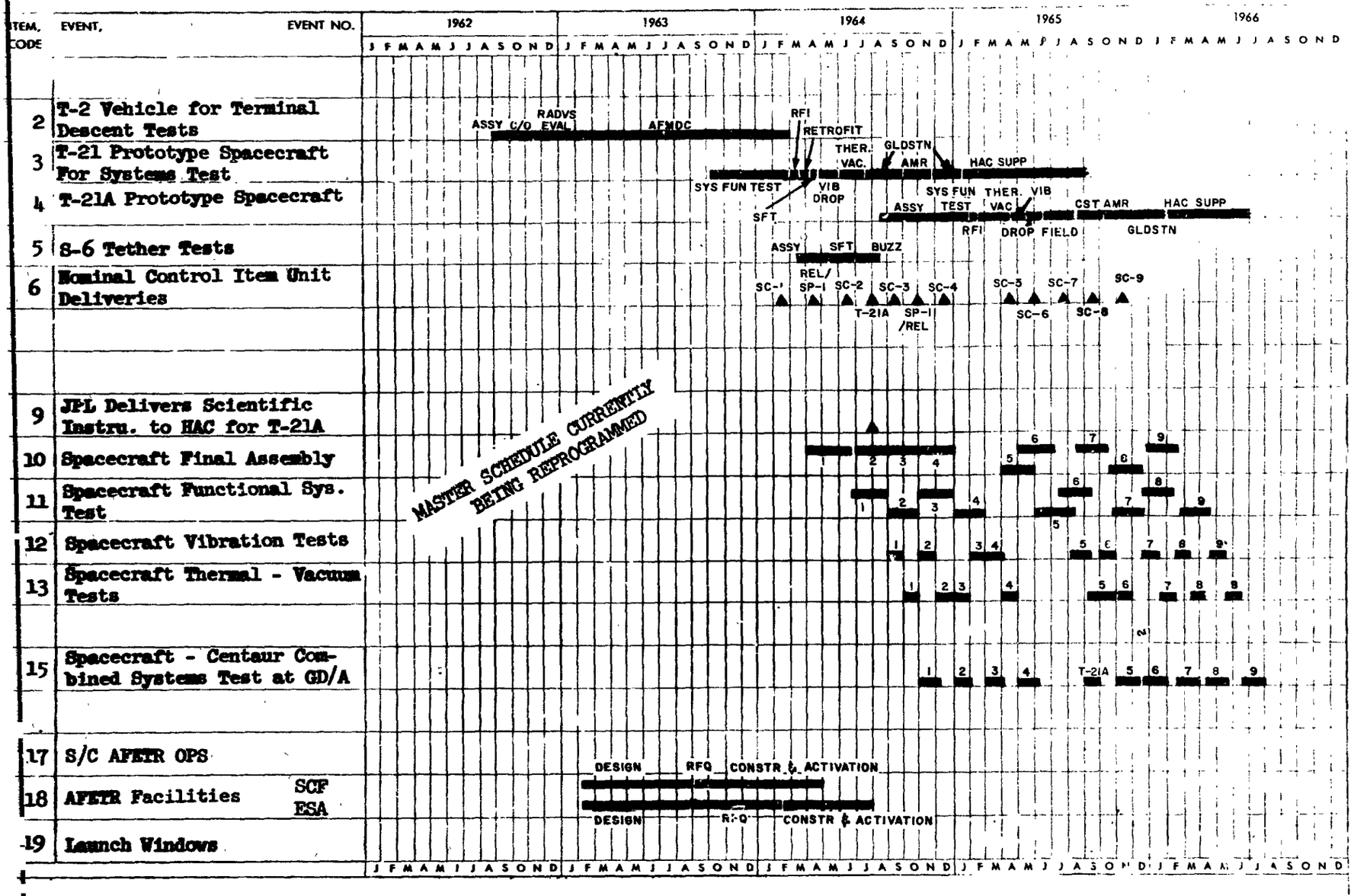
5.0 Vernier Thrust Chamber Assembly (TCA)
Thirty-three altitude tests have been performed to complete the re-start envelope determination. Data are currently being reduced. The thermal pattern has been established for the first four TCAs to be used in T-21 and component thermal control tests at HAC. **These four TCAs were delivered to HAC on 8 January 1965 - thus bettering the previous mid-January delivery date.**

Continued on page 16

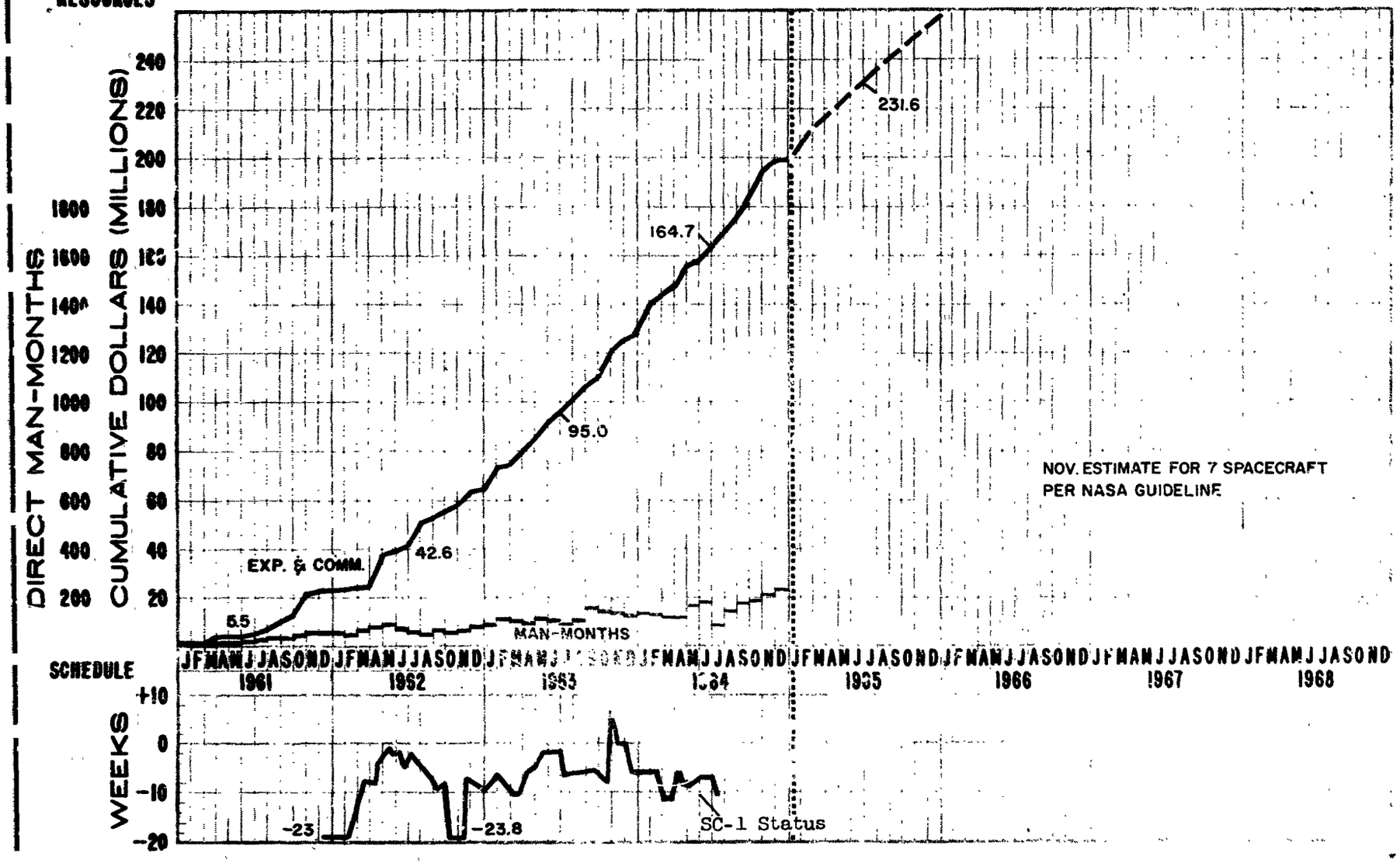
Project Master Schedule



Spacecraft Master Schedule



RESOURCES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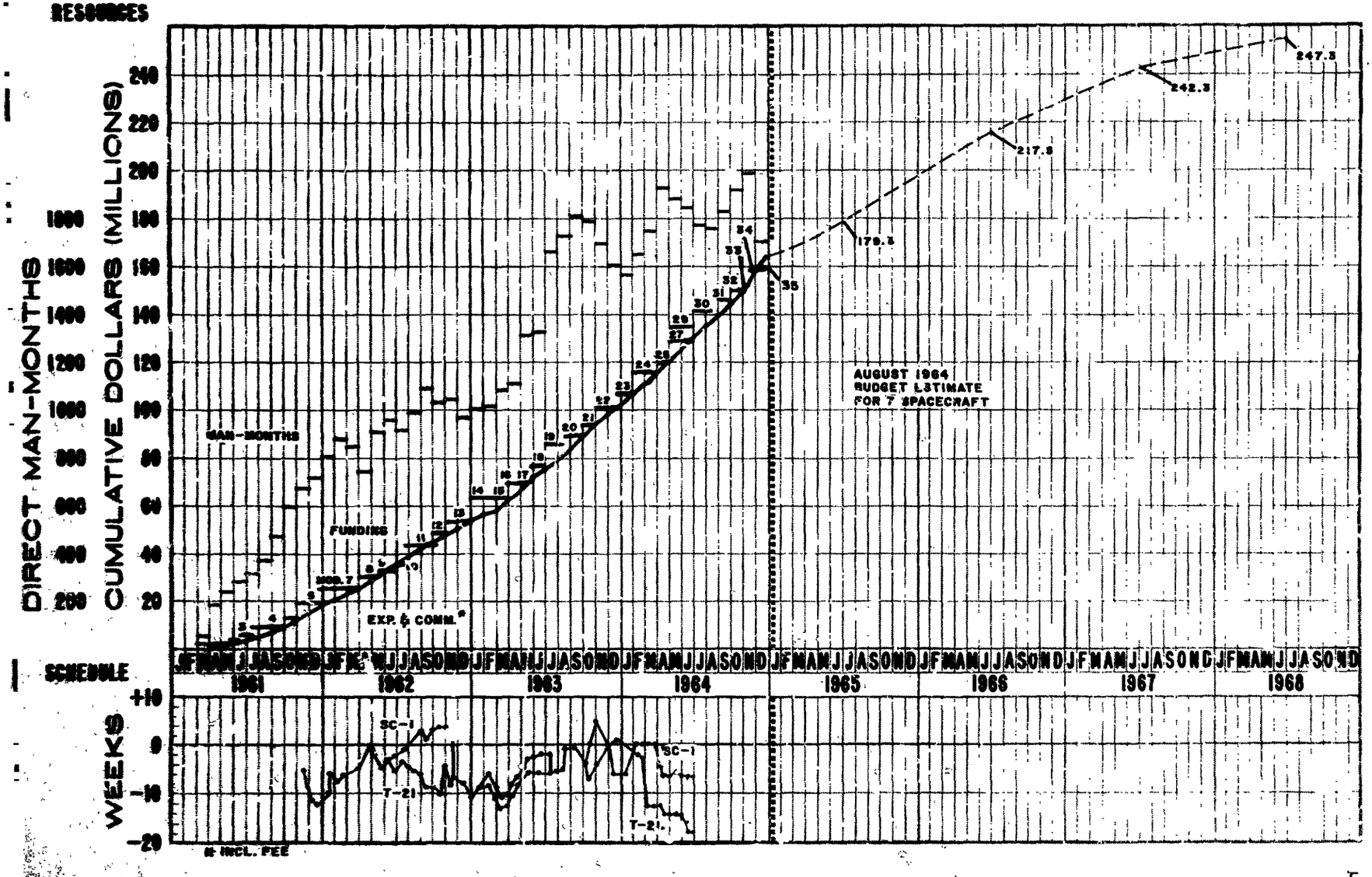
SC-1 Status

Surveyor Project Status Report AS OF: 8 January 1965 STATUS SUMMARY

ACTIVITY: SPACECRAFT SYSTEM



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.)			

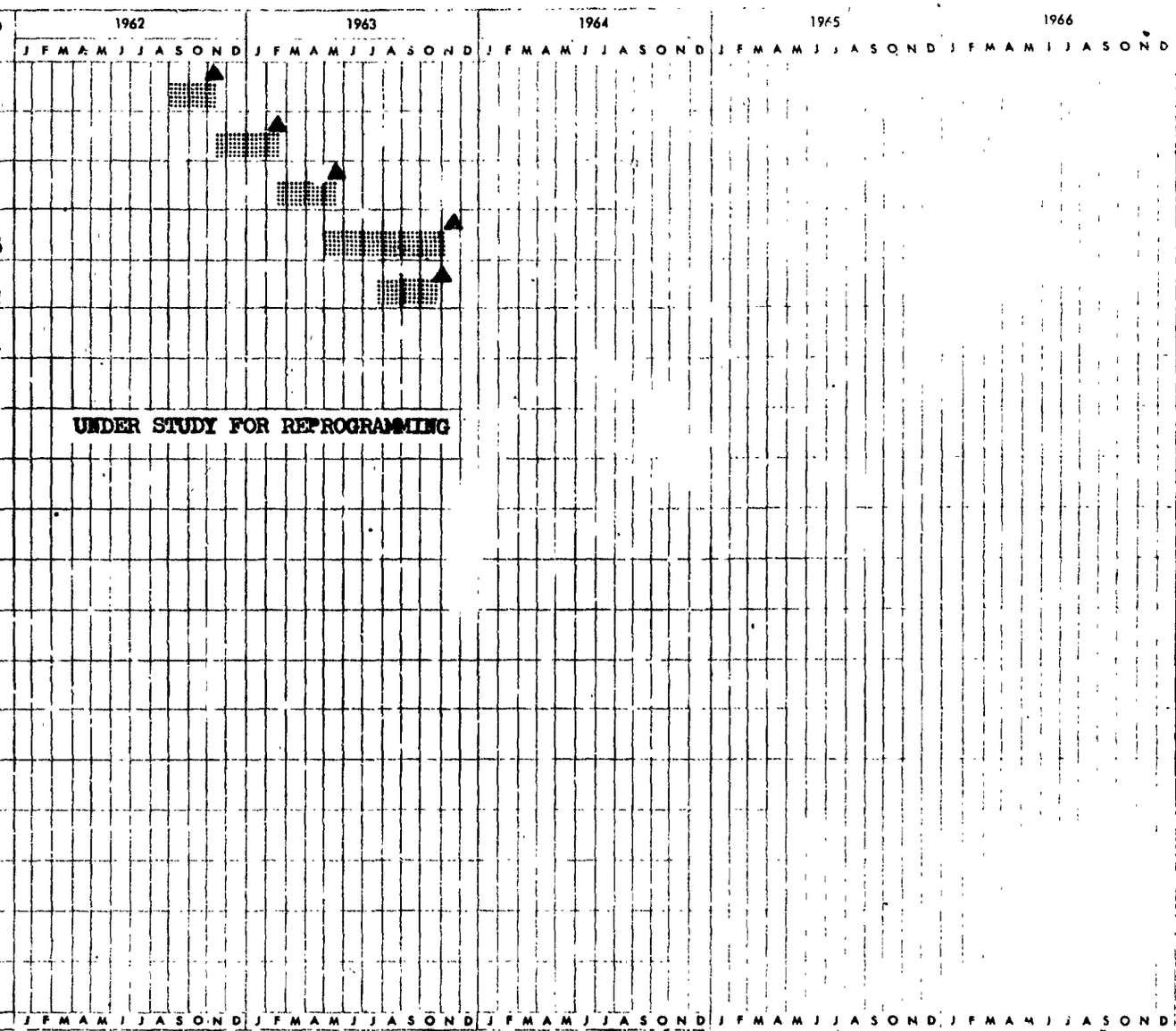
CURRENTLY BEING REPROGRAMMED

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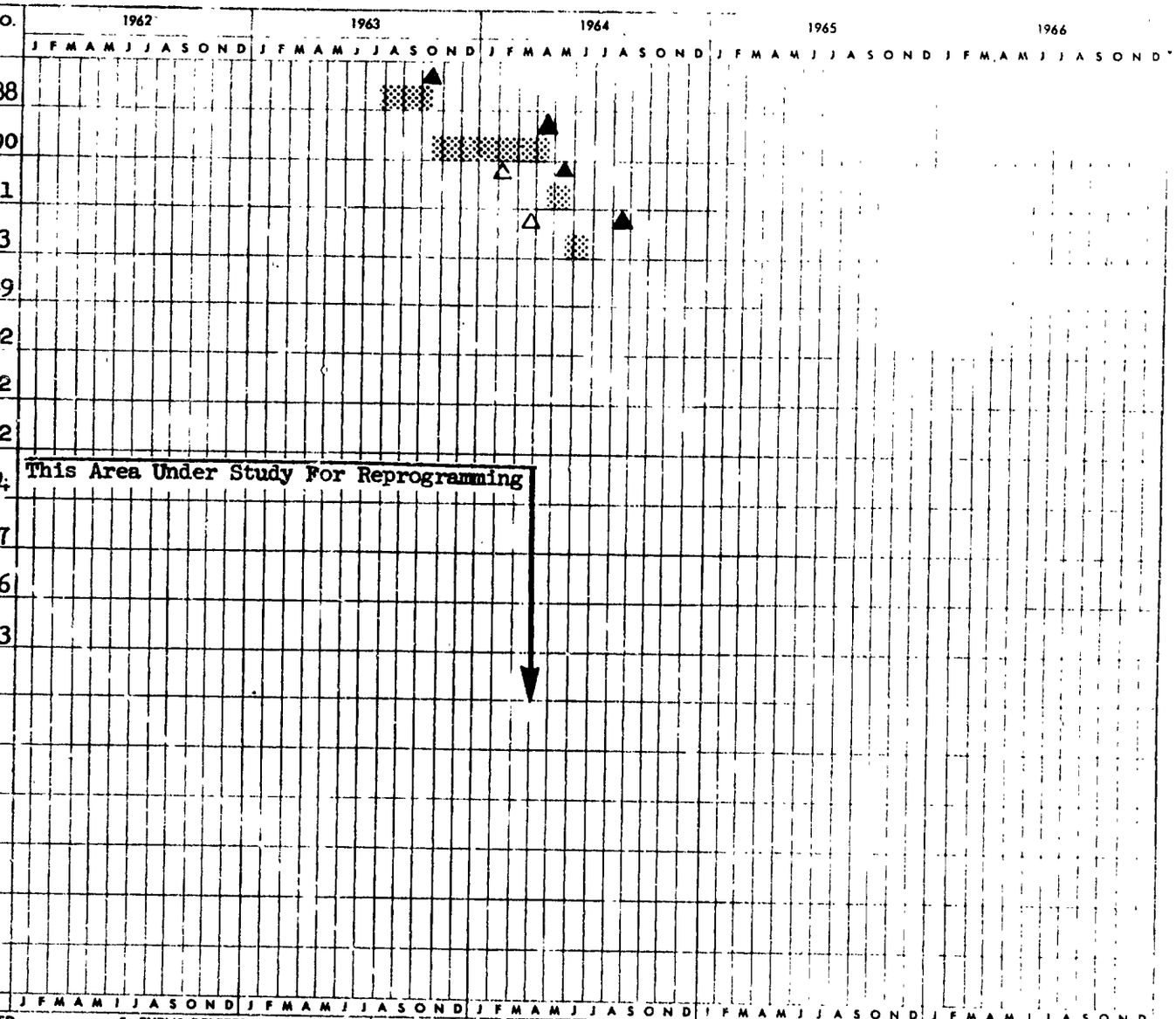
LEGEND: * SCHEDULED COMPLETION; EXPECTED COMPLETION; △ LATEST ALLOWABLE COMPLETION; ▲ ACTUAL COMPLETION

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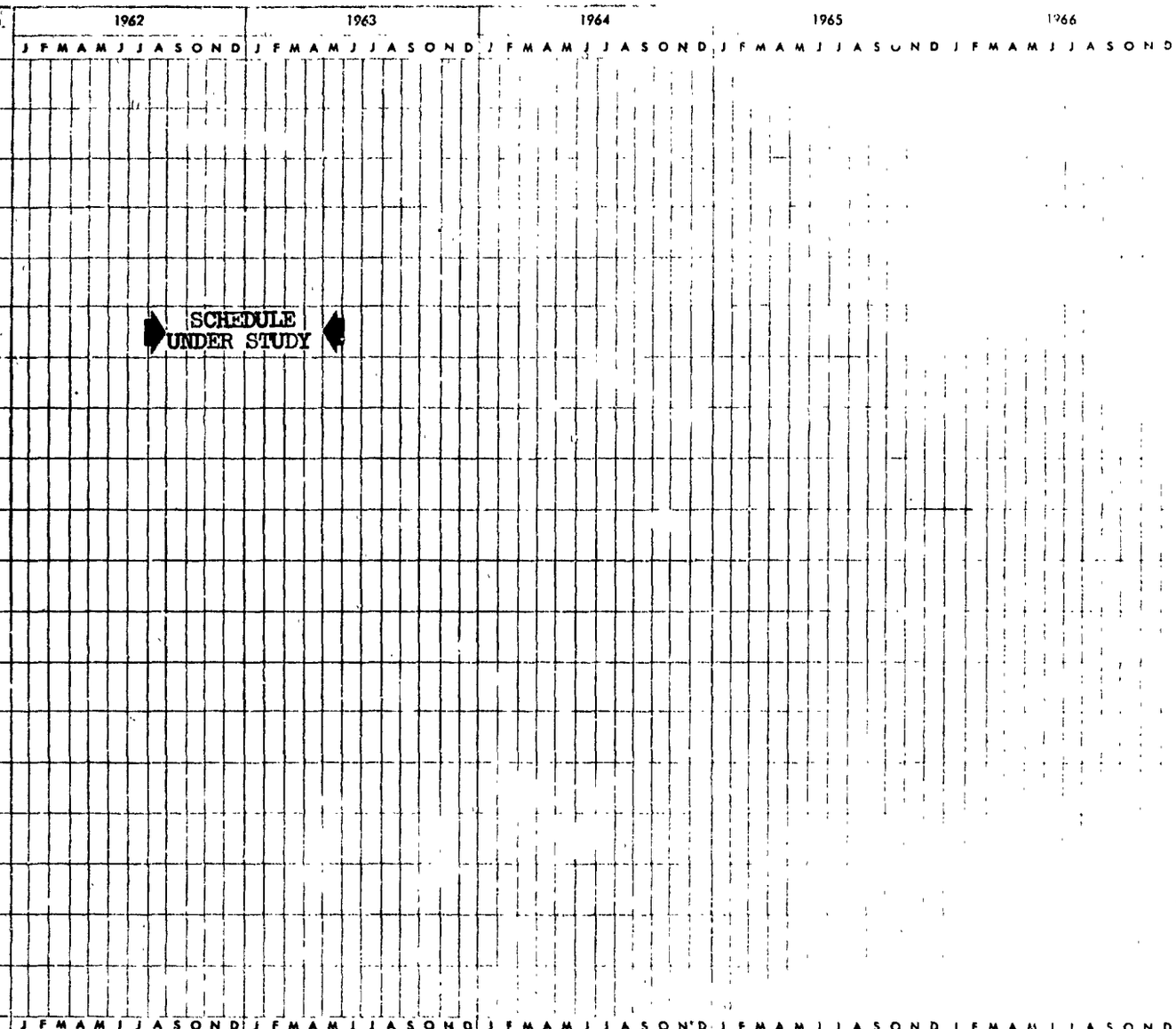
LEGEND: * SCHEDULED COMPLETION; EXPECTED COMPLETION; △ LATEST ALLOWABLE COMPLETION; ▲ ACTUAL COMPLETION

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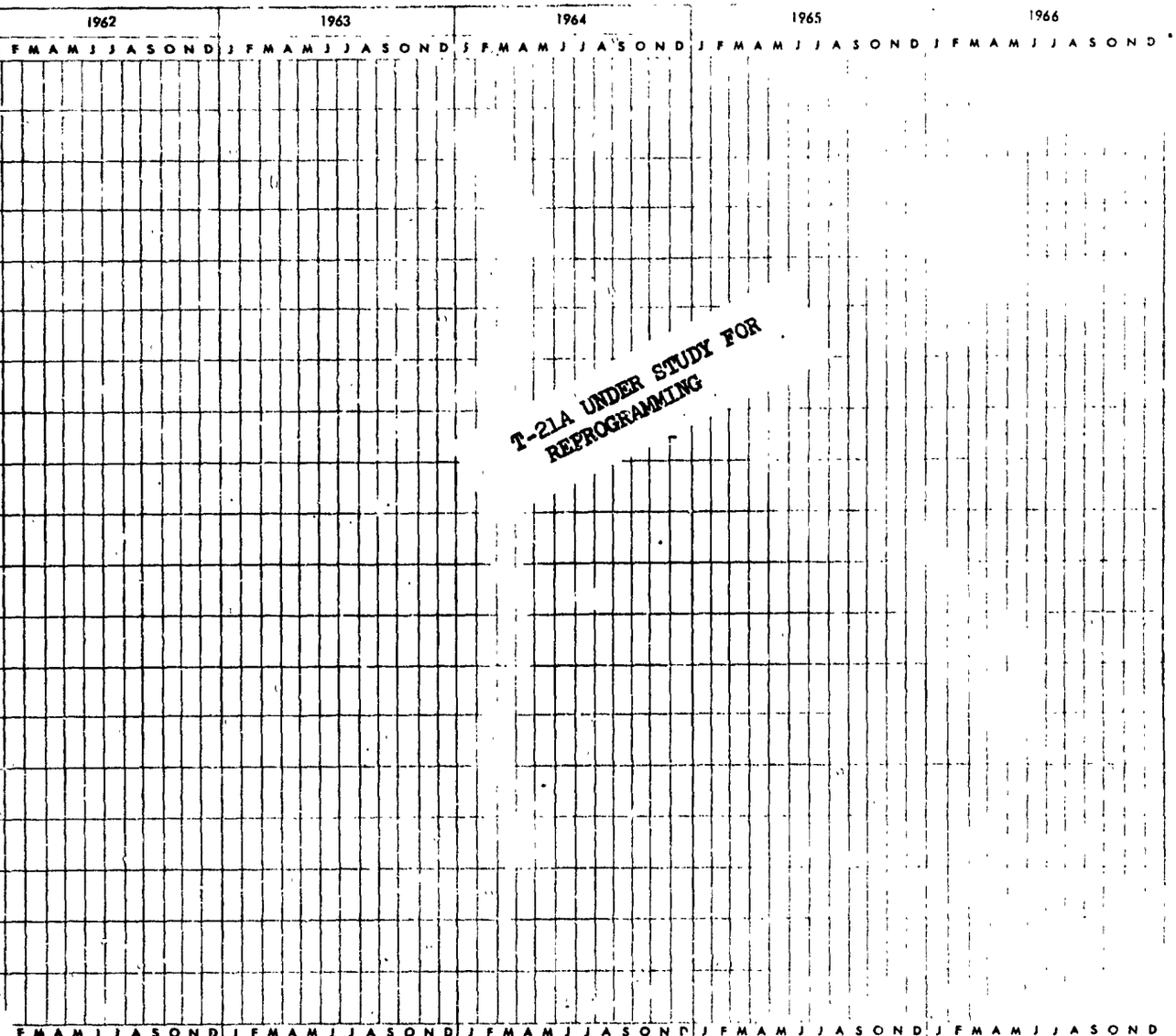
LEGEND: * SCHEDULED ≜ EXPECTED △ LATEST ALLOWABLE ▲ ACTUAL COMPLETION

Surveyor Project Status Report AS OF:

ACTIVITY: Scientific Payload T-21A

SELECTED EVENTS

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

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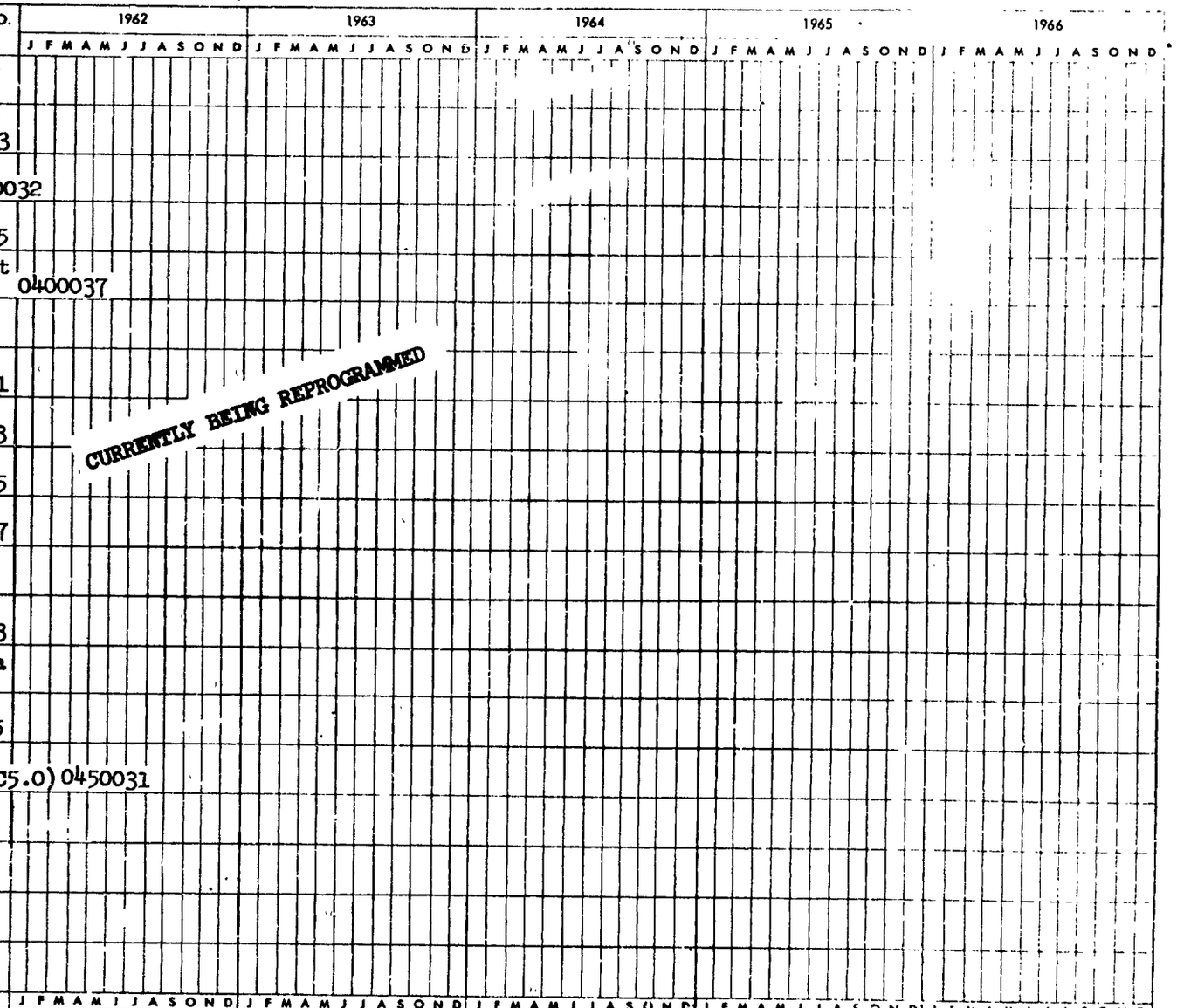
LEGEND: * SCHEDULED COMPLETION ≜ EXPECTED COMPLETION △ LATEST ALLOWABLE COMPLETION ▲ ACTUAL COMPLETION

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	040C071
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.

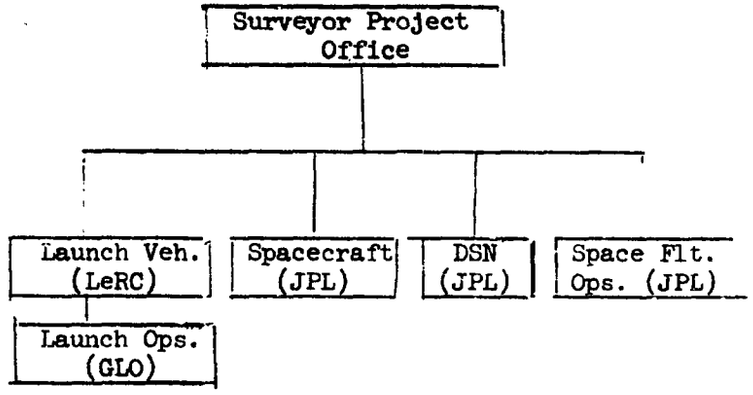
The Surveyor Project Block I currently comprises seven flight missions. These missions will utilize the Atlas/Centaur launch vehicle with launches to be conducted from Complex 36 at the Air Force Eastern Test Range (ETR), Cape Kennedy. The missions will be conducted utilizing direct ascent launch trajectories 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 prerelease 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 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)

6.0 Vernier Propulsion System

After upgrade of the suspension system and installation of new load cells, two additional expulsion unbalance tests were performed on 18 and 19 December 1964. The first test provided equal and unequal flows at ambient temperature. The second test utilized the same flow program with approximately 90° F temperature differential. The results are now being analyzed and, if no anomalies are found, this should conclude this phase of the test program. The S-6 vehicle will now be upgraded to incorporate flow blocks with fluid regulators, new throttle valves, and a new 6Al-4V titanium helium tank. Completion of upgrade is expected 29 January 1965, prior to starting expulsion flow dynamics tests 1 February 1965. The S-7 storage tests have been completed except for data analysis and component evaluation. The vehicle is currently undergoing substructure rebuild. New aluminum propellant tanks, a new helium tank, and new engines will be installed. Completion of this upgrade is scheduled for 15 February 1965. During this upgrade period, single engine firings will be performed to further explore the uncontrolled thrust "glitch" problem encountered in previous tests. Such firings will commence about 15 January 1965 and should be completed by 15 February 1965. Full system firings will then be performed and should be completed by 31 March 1965.

7.0 S-8 Test Vehicle

During this report period, testing of the S-8 vehicle was completed. A total of 87 test runs were conducted with several combinations of components from RADVS systems AM-1, AM-2, AM-3 and SN-1. Preliminary analysis of the RADVS operation indicate:

1. The RADVS system with db desensitization in the SDC performs adequately up to at least 56 lb. rms (15 db margin).
2. Without desensitization, operation seems marginal at 20 lb. rms or higher (6 db margin).
3. The crushable blocks are "visible" to the RADVS, and microwave absorber can reduce the extent to which they are seen.
4. The foot pads on the vehicle landing gear are "invisible" to the RADVS.
5. The AM-3 DVS antenna with special vibration isolators built into the attachment point performed satisfactorily.

A more detailed analysis is being continued to confirm and quantitize the above conclusions. After removal of control items, the S - 8 vehicle will be used in the thermal control model program.

Surveyor Space Operations System

1. The Surveyor - DSN Interface Document dated 25 November 1964, was finalized and issued as EPD 260. This document is scheduled for updating and reissue on 1 April 1965.
2. The DSN Committment Document (EPD 238 preliminary draft) was furnished to the Surveyor Project Office on 18 December 1964. The document is being reviewed by Surveyor personnel to ensure that it will satisfy Project requirements for DSN support.
3. The Surveyor Space Operations System detailed schedules (covering DSN and ETR support, computer programs, Surveyor Peculiar Equipment, and SFO training tests) were updated and issued as of 23 December 1964.
4. Preliminary A-1.2 training tests were initiated in the SFOF on 8 December 1964. Most of the computer programs required for these tests have been integrated, with completion of integration of all computer programs scheduled to occur 29 January 1965. At that time the formal A-1.2 training tests, involving use of all of the computer programs, will be initiated with completion of the tests

PROJECT SUMMARY (Continued)

scheduled for 26 March 1965.
5. The DDP 24 general purpose computer was delivered to Link, Palo Alto, on 4 January 1965 for integration into the Surveyor TV Ground Data Handling System.

MISSION OBJECTIVES

PD-31, The Surveyor Project Objectives and Flight Objectives for Surveyor Missions A - D was published on 6 January 1965 and forwarded to NASA Headquarters for approval on 8 January 1965.

This report has been distributed according to the Surveyor PSR Distribution List, of which the portion external of JPL is reprinted below:

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