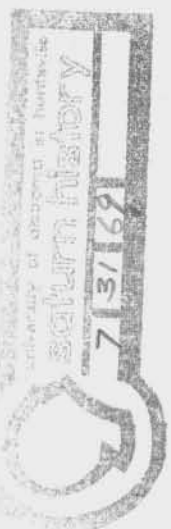


VI.06



MONTHLY PROGRESS REPORT

for July, 1969

Contract NAS 8-20055

SPACE SUPPORT DIVISION

Sperry Rand Corporation

This report, covering the activities of the Sperry Rand Space Support Division during the month of July, 1969, in support of the Astrionics Laboratory of Marshall Space Flight Center, has been prepared in accordance with the requirements of Contract NAS 8-20055.

The following pages contain reports for each of the individual contract appendices covering technical progress and accomplishments, related problems, and staffing progress. The report of manhours expended against each appendix by schedule order is being submitted as a part of the financial management report.

July 17, 1969

Mr. R. B. Douglas
Hercules Incorporated
910 Market Street
Wilmington 99, Delaware

Dear Mr. Douglas:

The University of Alabama Research Institute has been awarded a NASA contract (NAS8-21321) to perform a comprehensive history of the Saturn program.

In connection with this effort, we would appreciate receiving any documentation from you which you feel would be of use to us in the preparation of the history.

Thank you very much for your assistance.

Yours very truly,

David L. Christensen
Documentation Coordinator
Saturn History Program

DLC:jjp

APPENDIX A-1

TECHNOLOGY SUPPORT

I. TECHNICAL PROGRESS AND ACCOMPLISHMENTS
Schedule Order 201

Applied Physics Support Section

TD 105 Optical Communications Systems Development - Development of the two component visible laser communications system continued. A solution was found for the collimator light level problem through a re-design of the light source. The collimator is operating satisfactorily, and the light level is equally divided between the tracking and demodulation image dissectors. A preamplifier with automatic gain control was developed for the tracking image dissector and is being dynamically tested for frequency response. This preamplifier will compress signal variations caused by source scintillation.

Development of the CO₂ infrared communications system continued. A beam deflector amplifier breadboard has been completed and is being evaluated for distortion problems. The amplifier will be utilized in conjunction with the Sylvania PBM-SG deflector units.

Studies on the laser diode experiment continued. A high speed D to A converter was developed utilizing a modified R-2R resistive ladder network which is accurate to 12 MHz. A high frequency operational amplifier was successfully breadboarded and tested. The required specification was met. The amplifier specifications were:

Open-loop gain	-34db
Unity-gain bandwidth	> 250 MHz
Bandwidth (operated with 6 db gain)	120 MHz (at -3db points)
Output voltage capabilities	±2.5 v (dc to 12 MHz)

TD 107 Optical Pathlength Measurement System Development - This TD has been completed and all the objectives have been met within the allotted number of manhours. The final report has been completed and issued.

TD 109 X-Ray Telescope Optical System - Effort continued on the final report which includes a complete analysis of the X-ray telescope. The final version of this report should be available in September.

TD 115 Large Aperture Optics Research - Computer facility definition was studied for both real-time and normal processing requirements. A preliminary study of both the flexible and segmented mirror techniques was begun.

Solid State Research Support Section

TD 112 MIS Research Studies - The insulator film study continued with the primary effort being utilized for obtaining accurate data on film processing techniques. All films grown during the month had excellent physical and electrical characteristics. Rectangular reactor tubes were

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July, 1969

received and will be utilized in future experimentation beginning in August. A modulated beam photometer technique was adapted for making measurement of film thickness as the film is being deposited. This will allow more precise thickness control on nitride layers. A new technology report is being prepared on the modulated beam photometer technique.

TD 113 MOS Computer Systems Research - Final testing of the arithmetic unit has been postponed awaiting the availability of a temperature test chamber.

TD 116 Hybrid Component Evaluation - Standard evaluation and testing of seventy-two lots of capacitors, resistors, and transistors was successfully completed. Data on nine sets of tests were submitted for computer analysis and three test procedures written.

II. STAFFING

There are currently 13 people supporting this appendix.

July, 1969

APPENDIX B-1

ELECTROMECHANICAL ENGINEERING SUPPORT

I. TECHNICAL PROGRESS AND ACCOMPLISHMENTS

Schedule Order 202

Mechanical Engineering Support Section

TD 2001-3 ATM Solar Wing Test Program - Engineering support of the ATM Solar Wing test program continued. Developmental test studies were made on the cinching mechanism, the antenna release and deployment system, and the thruster.

The room temperature release tests on the cinching mechanism were completed and the results substantiated the design goals although the required release force was considerably lower than anticipated. The test involved approximately 500 successful individual and ganged releases without the pyrotechnic units. Future testing will include the pyrotechnic release mechanism. Testing will also be required involving high and low temperature and vacuum.

An improved antenna deployment spring is being designed and the plan for the antenna deployment tests is completed. The test fixture will be modified to include the improved spring and associated equipment.

Several new thruster designs were completed and the development test plans reviewed with the S&E-ASTN-T test personnel. Several thruster cases are being modified for utilization in the calibration and checkout of the test instrumentation before the developmental testing begins in August.

TD 2002-1 Design of the ATM Solar Array - Optimization of the antenna deployment system continued. Improved deployment springs, damping devices, and locking mechanisms are being investigated. The proposed drawing systems for the prototype and flight models was reviewed and the final drawings are being prepared by the off-site appendix.

TD 2004-1 ATM Infrared Test Cage Development - Development of a test cage for the thermal vacuum testing of the ATM rack continued. The relative locations of the IR lamps with respect to the ATM and the simulated lunar plane in the test chamber were determined and the lamp support structure studies were continued. Detailed specifications for the lamp positioning devices were completed and given to B-2 appendix for utilization in their design effort.

TD 2005-1 Container/Dolly for the ATM Solar Wing Assembly - Development of the container-dolly transporter to transport the ATM solar wing was continued. The program has been divided into three phases involving Phase I - conceptual design and analysis, Phase II - development and documentation, and Phase III - prototype fabrication and testing. The preliminary design is being developed and analyzed.

Electrical-Mechanical Fabrication Support

TD 4050 Fabrication Support for AAP and Saturn Equipment - Technician support was provided in the fabrication and modification of various test fixtures, PC boards, and hardware for Saturn, AAP and ATM tests. Assistance was provided in the setup and testing of the SO-56 X-ray telescope thermal vacuum testing.

Checkout of the Sulinac was started and several problems corrected. Further effort will continue when the main tank diaphragm is replaced. The diaphragm ruptured during pressurization of the chamber.

Work was started on obtaining test equipment and assembly of the Control Battery Regulator Module (CBRM) test specimen for test.

Environmental Test and Evaluation Support Section

TD 6001 Mechanical Dynamics Testing - Vibration tests were performed on the following items: ATM distributor, ATM camera and ATM camera control unit. The data recorded on these tests has been reduced and released to the requesting divisions.

Work continued on the installation of a common power and ground for the vibration area. Several ground problems have been eliminated in the exciter system and bus bars have been installed in the data acquisition system.

Acceleration and vibration fixtures were designed and fabricated for the ATM distributor and ATM CBRM tests.

TD 6002 Space Simulation Testing - The following tests are in process or completed in the thermal vacuum laboratory:

- (1) The SNAP 19 thermal vacuum test continued in process.
- (2) The SO-56 ATM X-ray camera vacuum test has been completed.
- (3) Three hundred thirty-six solar modules have been outgassed in thermal vacuum and the test is still in process.
- (4) The SO-56 ATM X-ray telescope thermal vacuum test is in process.
- (5) Outgassing tests on the ATM connectors are continuing.

The solar modules and the X-ray telescope have proceeded on a 24-hour-a-day schedule and should be completed the first week of August.

The connector outgassing tests were delayed for several weeks by major problems encountered in the Spectroscan 750 residual gas analyzer head and electronics. These problems have been solved and calibration curves have been made to establish a reference background in the vacuum chamber. Tests will begin immediately.

TD 6003 EMI Testing and Analysis - Development tests on the Metro-Physics prototype pressure gauge power supply and pressure gauge thermostat were completed. Both units met the requirements of MIL-I-6181D. The H-alpha camera zoom electronics were successfully tested to the transient susceptibility requirement.

Qualification testing was performed on the BBRC acquisition sun sensor and the Honeywell ATM fine sun sensor. There were several discrepancies found in the 50M02477 ATM circuit transient specification as a result of these test. Further investigation of the methods of interpretation and physical requirement is being studied.

II. STAFFING

There are 19 people presently supporting this Appendix.

APPENDIX C-1

COMPUTERS

I. TECHNICAL PROGRESS AND ACCOMPLISHMENTS Schedule Order 203

TD CF-1 P.U. Computer Checkout Console - The design of a test console adequate for making a performance evaluation of flight type propellant utilization computers was initiated. A meeting was held with S&E-ASTR-CFS to determine the test procedures and the hardware availability. Pin functions are now being prepared to define the location of the input/output and monitor points for the system.

TD CF-3 Saturn Control Hardware - One control signal processor was electrically tested and adjusted for use in the Saturn V breadboard area.

Two control computer anomalies were detected recently by KSC personnel. One involves a spatial amplifier output pulse width of less than the specified minimum during S-II to S-IV staging; the other involves noise transients which are fed back into the LVDA from the control computer. Both problems are under investigation; the results to date are incomplete.

TD CF-4 ATM Control Computer - A preliminary qualification test document was prepared and submitted to the technical contact for review. Corrections and additions will be made during the next reporting period.

One ATM control computer abnormality (analog integrator drift) is currently under investigation. The testing of the rate integrators for the prototype computer was completed. This work included drift tests with various combinations of temperature, scale factors, and several modified component configurations. These tests also included the characterization of printed circuit board materials with respect to electrical leakage, and the characterization of conformal coating materials. These tests were completed and a final report was prepared for the technical contact.

An integrator breadboard utilizing a Union Carbide integrated circuit operational amplifier was completed; evaluation is in process.

TD CF-5 Thruster Attitude Control System Requirements - The most recent revision of the Workshop Attitude Control System Document was reviewed and a preliminary tabulation of thruster attitude control system hardware requirements was made. This tabulation will be expanded and updated periodically as new requirements are developed.

A test plan for the control relay package life test was completed and the assembly of the required hardware and instrumentation was begun.

TD CGG-1/CGG-7 DDAS Computer Maintenance - TD CGG-7 was written which continued the work of and replaced TD CGG-1. Daily preventive maintenance support was provided on the RCA-110A system. Provided operational support by running magnetic tape updates on the 110A. Provided support in obtaining data on a noise problem that is affecting the operation of the 26-volt regulator in the RCA-110A computer.

TD CCG-2/TD CCG-9 RCA-110A Computer System/Saturn V System Simulator - TD CCG-9 was written which continued the work of and replaced TD CCG-2. A series of design review meetings with SDS on the new DEE-6 system were attended. The object of these meetings was to establish a different design philosophy for part of the DEE-6 hardware and software. Prior to and during these meetings, SDS provided preliminary drawings on their new system. These uncomplete drawings are under review.

TD CGO-9 Digital Evaluator (DEE-6) Support - During this reporting period, Sperry Rand personnel attended a series of DEE-6 hardware/software design review meetings. The purpose of these meetings was to obtain a better understanding of the new DEE-6 system and to suggest methods of improving the system.

An analysis of the SDS 92 software to be delivered as part of the new DEE-6 system was begun. This analysis is being performed on a program listing received July 17, 1969 and Scientific Data System DEE-6 Remote Scanner to SDS 930 "Y" TMCC Interface Document (Drawing No. 119118) Revision E.

TD CGS-1 Digital Program for SDS/Comcor Hybrid System - Debugging of the program was continued and is presently 80 percent completed. In debugging the program further hardware problems were detected in the discrete and interrupt circuitry of the hybrid controller. These problems were corrected and debugging was continued.

TD CGS-2 ATM Simulation and Hardware Integration - An automated static test program was written to check the static condition of the analog computer. The program verifies the patching of the problem and the static condition of the analog components.

The dynamic simulation of the ATM problem has been hampered by oscillations in the resolver section of the analog computer. The vendor is presently working to correct the oscillations.

TD CGS-3 Sigma 2 Display Software - By researching the FORTRAN library listing and a series of memory dumps, enough information has been learned about the Sigma 5 system to program an addition to the FORTRAN library called the WRTCRT subroutine. The WRTCRT subroutine uses the FORTRAN WRITE statement and the FORMAT instruction to compile a line of text into EBCDIC coding for transmission from the Sigma 5 to the Sigma 2 for placing the data on the display.

As of this date, the internal software associated with the subroutine display is not functioning correctly, or the procedure for using them as outlined by the vendor's instruction manual is incomplete. Work will continue in debugging the program.

TD CGS-4 Sigma 5 Fortran IV Compiler - The status of this TD has not changed since the last reporting period due to low priority and unavailable manpower. The completion date for this TD has been extended.

TD CGS-5 ATM Interface Diagnostic - The Sigma 5 monitor has been modified to allow communication with the ATM interface equipment. Two Fortran subroutines were developed using the change in the monitor to communicate with the ATM interface. In checking out Fortran subroutines, the technical contact developed a diagnostic program fulfilling this TD. Hence, the TD will be cancelled.

TD CGS-6 Flight Verification Equipment Diagnostic - No work was performed on this TD during this reporting period.

TD CGS-7 INTRACOM/APM Diagnostic Evaluation - Debugging was continued on the rewritten INTRACOM diagnostics. The discrete package is complete and debugging of the realtime entry, D/A's, and interrupts is 80 percent complete.

The analog (APM) diagnostics were modified but not completely debugged.

TD CGS-8 SEL 810A ATM Simulation Program - No work has been done on this TD since the last reporting period since the task is complete to the extent that the hardware will allow. This TD has been extended.

TD CGS-9 Checkout of DGP-6 Analog Control Interface - The DGP-6 Analog Control Interface program has been completed and is operational.

The operating instructions, flow charts and program listings are contained in report SP-525-0239, DGP-6 Analog Control Interface Checkout Program.

The task was completed on July 1.

TD CGS-10 Test Display Program for SEL 840K System - No work has been done on this TD since the last reporting period since the interface between the SEL-810A and the SEL-840A is being installed and checked out.

TD CGS-11 Magnetic Tape Read/Write routine - Five subroutines were developed in the completion of this TD. Two of the subroutines are used to initialize the buffer areas used in writing onto and reading from magnetic tape. Two routines are used to write on magnetic tape from specified buffers. The last routine reads data from magnetic tape as specified by the read initialization routine. The main function of these subroutines is to minimize the wait time in a real-time simulation application.

This task was completed on July 18.

TD CGS-12 ATM Battery Cell Matching Computer Programs - Systems analysis and programming on the ATM battery cell matching programs (cell-mate system) was continued. A progress summary for this reporting period follows:

(1) Changes were made to the cell matching monitor program which provide the capability of detecting analog numbers 448 and 449 as the charging current analog of all cells. Limited debugging of this program was continued.

(2) The writing of the software requirements for the cell-mate system was completed and submitted to the technical contact.

TD CGS-17 Update of Sampled Data Program - The continuous and sampled data frequency program was debugged with the capabilities it had when delivered, i.e., the computation of the frequency response, polynomial manipulation, and making Nyquist plots. The following features were added: (1) titling of the printout and plots, (2) phase scan of the data, (3) plotting of the $F(s)$ and $F(z)$ data, (4) finding roots of polynomials, (5) making a frequency response using the roots of a polynomial as opposed to using the polynomial, (6) input of roots to the routine, and (7) single and double precision versions of the program.

Test cases were run and the documentation completing this TD was delivered on July 18.

TD CGS-18 General Root Locus Program - In the modification of the existing program, a subroutine which found the roots of a polynomial would not work if the derivative equaled 0 for the initial guess of the root.

A test case is being prepared to completely check out this program. The documentation, with the flow charts and listings, is being prepared.

TD CGS-19 Plotter Software for the SEL-840A - The software package has been completed to the extent that the appropriate grid and curves can be plotted and that most of the desired program options have been checked out.

The incomplete portion deals with the labeling of the ordinate and abscissa. Due to a problem with the Benson Lehner-120 hardware, associated with the character printing, part of the program has to be modified. Program checkout can not be completed until this modification is made.

Documentation will include the appropriate program explanation and flow charts.

TD CGS-20 Saturn V Input Processing Program - The existing subroutine in the input processing program to calculate the bending data will be taken out and a new subroutine will be written which will obtain the bending data from a magnetic tape furnished by the user.

This task is an extension to the work initiated by TD No. R-ASTR-FO-7.

TD CGS-21 ATM System Response Analysis - The current ATM simulation on the SEL 840A/AD-4 system will be transferred to the Sigma-Comcor system.

The initial phase of the task will be on the linear ATM model. Presently the digital program is being developed and analog diagrams are being prepared for the linear model simulation.

TD CGS-22 Verification of Sigma 5/CI-5000 Hybrid Software - Verification of the CSSL, AAP, APV and EV software package for the Sigma hybrid system will be performed.

Differential equations simulating a simple mechanical model will be checked using the CSSL and AAP software.

CSSL generates a completely digital solution and AAP gives a patching procedure for an analog solution. The results of the two simulations will be checked against the known solution of the model.

The APV and EV software packages will be used in conjunction with the analog simulation since these packages insure that the problem has been set up properly. Static and dynamic checks of the analog simulation are also obtained using APV and EV.

TD CGS-23 84OMP EAU Diagnostic - A diagnostic program is being written to run concurrently in both CP's of the 84OMP system. The program is being written in two phases. Phase I - Functionally correct program (synchronization, error-checking, I/O, etc.) using a simple math model. This phase is approximately 90 percent complete. Phase II - "Rotating rod" equations will replace the simple math model of Phase I.

TD CGS-24 84OA EAU Diagnostic Program - No work has been performed on this TD. Work will begin following completion of TD CGS-23.

TD CGS-25 Sigma 5 Function Generator - This task consists of writing two subroutines. The first is a data preparation subroutine which will allow a user to define an independent variable, x , and obtain several dependent variables $f_i(x)$. The various values of these quantities are stored tables in the computer memory. The second is a real time function generator subroutine which will allow the use of a Fortran CALL to obtain the corresponding values of $f_i(x)$ using straight line interpolation.

The program is currently being flow charted and coded.

TD CS-1 Hybrid System Number 1 Support - This system has not been accepted by MSFC, therefore regular maintenance support has not been required. System engineers and technicians performed daily checkout to help define problem areas in the hardware. On the Sigma 5, a memory plane, power distribution relay, a logic module, and two muffin fans failed and were replaced by Astrodata Inc. Several power supply problems in the D/A and A/D converters were resolved. In the analog portion, a spurious oscillation problem is now being investigated.

TD CS-2 Hybrid System Number 2 Support - System engineering operational and maintenance support were performed during the month of July. Diagnostics were run daily to verify the system operation using the daily checkout procedure. The disc developed an intermittent problem that was

corrected by replacing the drive brake and having the air conditioning repaired. The system has developed an intermittent problem such that bit 16 is being dropped between the I/O devices and the central processor. The amount of time lost because of this problem is not significant, and due to its highly intermittent nature it has been difficult to diagnose. Some other minor problems were encountered and corrected without appreciable downtime. All failures and corrective actions were recorded in the system log book.

A daily checkout program is being written to assist in the daily checkout routine and is being used in a preliminary version.

TD CS-3 Hybrid System No. 3 Support - Daily preventive maintenance and diagnostic programs were performed on the system. A disc heating problem is presently being investigated.

Just prior to the launch of AS-506 the card reader's nylon drive gear sheared off a number of teeth. This gear, the major throat shaft assembly, picker roller, and belt were replaced and adjusted. In the process of verifying the card reader a mis-registration error was eliminated by correcting a cold solder joint on a photo diode.

Alignment of photo diode lamps used on the line printer's code wheel corrected the situation that caused intermittent double printing and characters to be dropped. Magnetic tape handler "C" would run forward during a write operation on "B". This was corrected by adding a decoupling capacitor across the MTU logic bus and using an inverter card with better noise rejection.

A CI-5000 -150 volt amplifier power supply voltage was high. The regulator circuit involved was repaired. Three HODAD's and one HODAD compartor were replaced on this system.

TD CS-4 Hybrid System No. 4 Support - The digital portion of the system is in process of being interfaced with its peripheral units and made operational. The Ampex TM-9 tape handlers, their MTU's, and the TCU are now being checked.

The servo system for setting potentiometers on DC-8 was repaired. Two servo potentiometers and three amplifiers were replaced and repaired on DC-4.

TD CS-5 Hybrid System Number 5 Support - Daily checkout, calibration and preventive maintenance were performed. All component failures were listed in the log book.

During July there was no loss of operating time on any of the equipment that is included in this TD.

Two failures in the address system, a multiplier and integrator, were repaired on the DC9 Analog Computer. Three delay lines on DGP2 were adjusted.

TD CS-6 Hybrid System No. 6 Support - Diagnostic testing, preventive maintenance, and calibration were performed on the system. The most significant failure that occurred during the month of July was a problem with the CI-500 analog computer network control circuitry.

A diagnostic has been checked out and hardware malfunctions corrected which allows the three counters and the 16-bit register in the SVS-ASTEC buffer to be checked daily. A diagnostic to check the A/D converter channels has also been modified and is now operational. These diagnostics were a part of the hybrid simulator systems diagnostic described in Sperry Report No. SP-210-0021.

All maintenance activities were recorded in the systems log books.

TD CS-7 Hybrid System Number 7 Support - Daily checkout, calibration, and preventive maintenance were performed during the month of July. The systems original disc drive that was temporarily replaced in June was re-installed in this system.

The interfaces for the card reader and card punch are being installed in the I/O devices.

Some minor problems were encountered and corrected without appreciable downtime. All failures and corrective actions were recorded in the system log book.

TD CS-8 Maintenance on Benson-Lehner Plotting Systems - The Benson-Lehner plotters were tested and cleaned daily. The only significant failure that occurred during the month of July was a problem with the alarm circuit in the BL-120 plotter.

A fan has been mounted on the rear of the BL-120 CRT chassis to provide cooling for the printed circuit cards located there.

TD CS-9 Digital Filter Development - The final electrical checkout of the digital filter is nearing completion. The filter generally is functional in all areas but malfunctions intermittently. Several selected modes of operation which were used to demonstrate the Auburn University filter have been tried with success. Some difficulty has been experienced when implementing Laplace transfer functions, which indicates a need for further review of the theory of operation. Development of a set of coefficient tables versus normalized output may be required to permit a complete checkout.

TD CS-10 Development of Shaping Networks Programs - No work in this area was requested during the reporting period.

TD CS-11 Daily Check of DTV Trailer - During checkouts of the DTV trailer this month a few minor problems were discovered in the Brush recording equipment. The problems consisted of a bad amplifier and a broken band on a penmotor. Both of these problems have been corrected using available spare parts.

NASA maintenance crews have corrected the problems in the air-conditioners in the DTV trailer. No other problems have developed in this area.

TD CS-12 Mechanical Design Support - During the month of July designs were completed on an overtop section for a SEL-810 computer, modifications to a three-phase power supply, a nylon gear for the Uptime card readers, a patchboard storage fixture, and a printed wiring board for DC-1.

Other work completed includes silk screening four meter scales, layout of a system scheduling chart, drawing a "J" size electrical schematic of an ATM simulator panel wiring, and completing drawings of the Computer Division office layout.

TD CS-13 Central Simulation Equipment Spare Parts System - This TD was cancelled by S&E-ASTR-CS due to extended delay in obtaining the required floor space for the parts room.

TD CS-15 Saturn V: S-II & S-IVB Stage Dynamic Simulation - The equation structure development, preliminary logic flow diagrams, and the analog wiring diagram for the S-II stage dynamic simulator have been completed. The analog portion is being patched.

The digital portion of the simulation is being investigated to ascertain if a state variable or matrix type development might be simpler and easier for development and change.

TD CS-16 SDS 930A, 930B, and 910 Computer Facility - Systems engineering, operational, and maintenance support were performed during the month of July.

Support was provided in the activation of the DEE/Cell-Mate system. Checkout of the discrete relay chassis was continued, with approximately 50 percent of the checkout completed.

A list of hardware items which should be covered in the SDS maintenance contract was compiled and submitted to S&E-ASTR-CSO. An inventory of the present level of 910 spares was completed. A survey of 930A and 930B computer usage was performed.

Upon installation of the RCA-110A IODC's, corrective maintenance was performed on the simulator/110A interface. The installation of the computer-to-computer coupler has been temporarily discontinued pending arrival of the designer from SDS/Maryland.

Operational support was provided in the debug, assembly, compilation, and execution of computer programs for S&E-ASTR-, S&E-COMP, and S&E-QUAL. Debug of the SDS real-time monitor compiler was continued.

TD CS-17 General Simulation Support - Approximately 1500 cards were punched for use in simulations.

One report was typed in both rough and final form, prepared for reproduction, and assembled for distribution.

TD CS-18 ATM Motion Simulator - Drawings for an adjustable mount for the acquisition sun sensor were prepared and the item was placed on order. A surface mirror to be used for alignment purposes also was specified and ordered. Two supports necessary for handling torque measuring fixture clusters and control moment gyros were sketched, ordered, and received. A commentary on the encoder section of the Owens Illinois instruction manual was made for the technical contact. A number of suggestions for improvement were made.

Owens Illinois representatives were present during one half of the reporting period. During this time, no acceptance tests were made. A number of Owens Illinois efforts, however, were monitored and/or observed.

A problem exists in the area of documentation. A complete set of drawings for the simulation equipment is not available. Some of the existing prints should be corrected and updated. A corrected and edited instruction manual also is needed. It is believed that efforts should be made to obtain these items from the vendor to expedite future diagnostic and maintenance procedures.

TD CS-19 ATM Simulation Console Facilities - Work is in process on the Experiment Pointing Control portion of the console facility. In particular, attention is being directed toward completion of the fine sun sensor panel, flight digital computer panel, star tracker panel, and electrical support equipment panel.

A preliminary design for the required fine sun sensor panel electronics circuitry was made including a listing of required piece parts. The design included a conversion of binary/2's complement code to signed NBCD code. A parts order will be prepared within the next week. Detailed requirements for the digital computer and star tracker panels are being determined and tabulated preparatory to detailed circuit design. The electrical support equipment panel electrical schematic was prepared and the front panel mechanical layout is complete. A number of miscellaneous tasks (breakout boxes and other testing aids) were completed.

A polarity chart for the ATM control system is being prepared and is presently 95 percent complete. A review was made of the control computer monitor points to determine which ones could be eliminated without loss of critical data from the telemetry channels. ATM control computer pin functions and ESE requirements were updated and made available to the technical contact. A study is presently being conducted to determine the changes in pin functions, ESE requirements, test procedures and telemetry listings due to the "dry" workshop -ATM concept.

TD CS-21 AS-506 Guidance Dynamics Simulation - The six-degree-of-freedom hybrid guidance simulation was updated to the AS-506 vehicle configuration. A restart feature was installed in the simulation program to reduce the run time.

A total of 15 boost and 17 restart simulation runs have been completed to establish the satisfactory performance of the system. The data collected from the runs are being processed in preparation for a final report.

TD CS-22 ATM System Response Analysis - The ATM simulation in the SEL-840A/AD-4 system was used to obtain data for use in a gain variation study. The data were in the form of strip chart recordings and points on a Nyquist plot. Thirty-five simulation runs were made saving the strip charts. Approximately one hundred runs were performed to obtain points for Nyquist plots.

TD CS-24 Experiment 15 Support - A 60-foot cable has been constructed and installed between the tracking mount and the servo rack.

All interconnecting wiring has been done between servo amplifiers and the demodulaboratory in the servo rack via a central tie-point panel. A final checkout of all wiring was completed.

All wiring done under this TD has been documented and this documentation was delivered to the NASA technical contact.

This TD was completed on July 29.

TD CS-26 Sigma 5/Comcor Interface Checkout - Functional tests were completed on all the 96 D/A channels and the 32 A/D channels. Six randomly selected D/A channels are being thoroughly tested to ensure they operate within the vendor's published specifications. Linearity, noise level, and accuracy checks were completed during this reporting period. The remaining tests of phase shift, drift, and input impedance are continuing.

TD CS-27 Relocate and Install AD-112 Analog System - Research is now being conducted to determine the present interface configuration and what interface modifications and design work must be performed to meet the requirements for the system.

S&E-ASTR-CS is now in the process of determining the requirements for the system.

TD CS-28 System Description of OWS Simulation Facility - No work was performed on this TD during this reporting period. Documentation necessary for initiating this task has not been received by the technical contact.

TD CS-29 Update DC-1 Analog System - A general work plan and schedule has been developed for the conversion of this system. The system requirements are presently being studied and an inventory of the hardware on hand is being conducted. Disassembly of the old system is scheduled to begin August 3.

TD CS-30 SDS/ATM Linkage Checkout - Cables have been fabricated and installed between the SDS/Comcor and the ATM simulator console. The 48 analog channels have been checked out and are operational. Further tests are necessary for the logic interface verification.

II. STAFFING

The appendix is presently staffed with 56 people which includes one summer hire. One more person will report on August 5 and another on August 11, bringing the appendix to its authorized level.

July, 1969

APPENDIX D-1

FACILITIES ENGINEERING

I. TECHNICAL PROGRESS AND ACCOMPLISHMENTS

Schedule Order 204

TD 38 Facilities Engineering - Mechanical

A. Operation and maintenance of mechanical facilities are being performed as defined in TD 38 or as otherwise required.

B. Fabrication and installation of new systems, and equipment and modifications or removals of existing systems were performed as required by written task orders. Three task orders that were issued in June were completed, seventeen new task orders were issued, and eleven of the new task orders were completed.

C. Tasks Completed:

- | | |
|------------|---|
| Task 33-52 | Welded two (1½ inch) tube fittings on LOX tank vacuum line located at east end of A Wing, Building 4478. Completed vacuum pump and checked for leaks. |
| Task 33-57 | Installed a helium gas vessel and control station at the east end of Building 4476 and connected the equipment to the existing supply manifold. |
| Task 33-61 | Modified the compressed gas control station for B Wing of Buildings 4487 and 4436. |
| Task 38-3 | Removed the existing 30 gallon Freon storage vessel from Room B-138 and installed an aluminum, 100-gallon vessel. |
| Task 38-4 | Changed all filter elements in the C-Wing boring mill hydraulic systems. |
| Task 38-5 | Installed guard rails and signs around helium facility at Building 4475. |
| Task 38-6 | Installed a 1-inch solenoid valve with bypass in the cooling water inlet line of the constant azimuth centrifuge cooling system. |
| Task 38-7 | Installed approximately 30 feet of Armaflex insulation on air lines in Room 113 of Building 4476. |
| Task 38-8 | Modified water cooling system to the environmental temperature chamber in Room CC-105 of Building 4487. |
| Task 38-9 | Modified the high pressure air control station to the Sulinac in Building 4476. |
| Task 38-10 | Completed the hydraulic filter element inventory in Rooms CC-115, CC-116, CC-117, CC-119, CC-120, CC-121, A-120, A-121, and A-122. |
| Task 38-13 | Removed, cleaned and reinstalled cooling shroud in environmental chamber of Building 4476. |
| Task 38-14 | Made inventory of materials and spare parts in Trailer 2756, Room CC-128, Fitting Building, and CC tunnel. |

- Task 38-15 Modified existing low pressure air manifold and installed a control panel in Room A-224-2 of Building 4487.
- D. Tasks Not Completed:
- Task 38-1 Fabricate GN₂ control station as indicated on attached sketch, (75 percent complete).
- Task 38-2 Fabricate and install GN₂ control station as indicated on attached sketch (10 percent complete).
- Task 38-11 Modify compressed air supply to data link cables in Building 4436, (20 percent complete).
- Task 38-12 Modify fuel cell helium system, hydrogen and oxygen control system, and mounting panels in Room A-125 of Building 4487, (10 percent complete).
- Task 38-16 Regenerate HB 455 (two bed) dionizer, (10 percent complete).
- Task 38-17 Paint following equipment: (1) Air compressor and associated equipment in Basement A; (2) Helium control station and associated equipment at Building 4476; (3) Flex hose fabricating equipment in Room B-138; (4) Control station and associated filter assemblies at Building 4436, (25 percent complete).

TD 39 Facilities Engineering - Design

- A. Tasks Completed:
- Task 39-10 Made drawing for seal around overhead door in Room 113, Building 4476.
- Task 39-11 Made number plate for Room AA-126, Building 4487.
- Task 39-13 Made drawing for preparing parking area around Building 4487.
- B. Tasks Not Completed:
- Task 39-1 Make alterations to BB Cleanroom to provide for vacuum coating machine, photo lithographs, dark-room with fume hood, fixtures, and diffusion furnaces. Provide dark ceiling, painting walls black, and making electrical and plumbing changes, (50 percent complete).
- Task 39-2 Provide engineering and design to install temporary cables in conduits between Buildings 4487 and 4436, (held up) NOTE: Tasks marked "held up" are pending because all available manpower is being used on Task 39-14.
- Task 39-3 Update location map by deleting the following buildings; 4472, 4493, 4741, 4245, 7231, 4743, and Trailer T-4742, (held up).
- Task 39-4 Prepare survey report for all buildings and trailers assigned to Astrionics Laboratory, (held up).
- Task 39-5 Provide engineering design and drafting to relocate the ATM solar cell test facility from Trailer T-41 to Building 4373 Annex, (held up).

- Task 39-6 Design and prepare drawings for installation of chamber in Room A-120, Building 4487. Installation includes electrical power and drain facilities, (held up).
- Task 39-7 Design and prepare drawings for utility changes in Rooms 1, 2, and 3 of Building 4650, (held up).
- Task 39-8 Provide engineering design and drafting services for connecting the LOX storage vessel system into the existing supply line to the Fuel Cell Laboratory in the east end of A-Wing Building 4487, (held up).
- Task 39-9 Provide drafting for revising and updating drawings PCF 4475, 2165, and 2166, (held up).
- Task 39-12 Provide engineering design and drafting to install window-type air conditioning units in Rooms D-201-1 and D-213, Building 4487, (held up).
- Task 39-14 Provide design and drafting to prepare architectural, mechanical, electrical, and civil drawings for the alteration and relocation of laboratory, and office space in Building 4487, (40 percent complete).

TD 40 Management Information

- A. Various surveys and investigations were made in Building 4487 for use in preparing modification drawings.
- B. Corrections were made on Sperry's "On Site Personnel" charts each week and were replaced in the Sperry Manager's office.
- C. Various reproduction jobs were performed for the facilities group.

TD 41 Materials Specialist Group - The following services were provided during the month of July:

- A. Deliver, move, relocate, and store office equipment as required for normal laboratory operations, (194 jobs were performed).
- B. Deliver printout paper for computers, (4 deliveries were made).
- C. Two fire extinguishers were referred and replaced.
- D. Twenty-one gas bottles were delivered.
- E. Sixteen trips were made to the warehouse.

TD 42 Power Distribution Centers

- A. Operation and maintenance of Power Distribution Centers are being performed on a daily basis.
- B. Fabrication, installation and modification of existing equipment and facilities are being performed as required by task orders. No task orders were received this month.
- C. The following task order is still being delayed pending fabrication of cables: Task 37-3; Install remote control cable for Power Supply, Building 4492.
- D. A survey was made of all power receptacles in Wings B, BB, C and CC. Panel schedules were also made.

II. STAFFING

There was one resignation at the end of July, leaving a permanent staff of 26 against 27 authorized. In addition, there are three temporary and one summer employee assigned to this appendix.

July, 1969

APPENDIX E-1

ELECTRICAL DIVISION

I. TECHNICAL PROGRESS AND ACCOMPLISHMENTS

Schedule Order 205

TD 1 ESE Documentation Control - Processing of documentation by the ESE Design Standards Data Center was continued with 71 documents catalogued; 42 documents loaned; 91 documents ordered; 3 mod kits processed; and 142 parts lists received, processed and filed.

TD 2 Maintenance of ESE Reference Schematics - In the Saturn V ESE schematics there were 11 revisions in S-IC for vehicles 506, 507 and 508. In S-II, there were 16 revisions for vehicles 506, 507, 508, and 509. In S-IVB, there were 12 revisions for vehicles 506, 507, and 508.

Saturn V stage schematics had three revisions for vehicles 507, 509, and 510 in the S-II stage. In the S-IVB Control Drawings there were 14 revisions for vehicles 505 through 515. In the S-IVB Instrument Drawings, there were four revisions for vehicles 506, 507, and 508.

TD 3 ATM Electrical Power Subsystem - Emphasis was placed on preparing a prototype Charger/Battery/Regulator Module (CBRM) for thermal vacuum testing by August 4. The CBRM is being assembled and tested without problems at this time.

Another prototype CBRM and an engineering model CBRM are being built and tested. The engineering model is in test. It was necessary to build special test equipment to test the CBR subassemblies and final assembly. The test equipment is completed and in use. The second prototype CBRM is 10 percent complete and behind schedule for the projected delivery date of September 1. This date can not be met because parts that were to be expedited by being purchased locally, have not been received. These component parts are the pacing item for the second prototype.

Assistance was provided to off-site personnel for the documentation of test procedures and drawings for the CBRM. These areas are proceeding without problems.

TD 4 LLL TV Camera System - Parts were supplied for the first camera power supply and an engineer was provided to assist with testing of the power supply. Parts were supplied for the second power supply but not for the third unit. The third unit will not meet the shipping schedule unless the P. R. Mallory Company can provide capacitors by August 4.

The sync generator and video switch are awaiting parts that are on order. It was necessary to assign a man to expedite parts for these units. Purchase requisitions must be submitted for local purchases for those parts that are late.

TD 5 ATM NRL/HAO Experiment Power Supplies - Drawing changes were submitted to eliminate nonapproved material from the parts list and to correct drawing dimensions.

A review of the parts status indicates that many parts have not been received.

TD 6 S-IVB Workshop Experiment Power Supply - Component parts are being prepared for transfer to a fabrication area. Housing drawings were submitted for fabrication. Drawing changes were submitted for correction.

TD 7 ESE Cable Test and Evaluation - Tensolite wire testing has been completed. Tests on the Raychem wire and on the lacing tapes are continuing on schedule. A request has been received for inspection of flat conductor cable. "C" revision to MSFC-SPEC-332, the cable specification, has been typed in preliminary form. A sample listing of slash sheets was prepared for the customer for review and approval. Drawing 40M51251, was released.

TD 9 ATM Ni-Cd Battery Applications Analysis - Two ATM type Ni-Cd batteries are presently on test. One has been subjected to over 2,300 simulated ATM cycles at 0°C. The most recent capacity test indicated 23 ampere hours of useable capacity. Subsequent tests will determine battery recharge fraction characteristics between 100 to 300 watt loads in a temperature range from 0° to 30°C. Battery capacity trends will also be monitored.

The other test battery has completed a 1,400 cycle 30°C capacity degradation test followed by a 1,200 cycle capacity recovery test. The recovery test data indicated that battery capacity can be partially recovered when the battery is cycled at 0°C. The gain in useful capacity will be lost when the temperature is increased. The recovery test is being repeated to verify previous data.

A report has been submitted on the comparative performance of GEAB10 and GEAB12 type Ni-Cd cells.

TD 10 Single Cell Fuel Cell Evaluation - The test stand has been redesigned and modifications are 40 percent complete. The new design will allow easier system operation and will alleviate the maintenance problems.

TD 11 DVT Fuel Cell Evaluation - No effort was expended on this TD.

TD 12 ATM Solar Cell Module (SCM) Performance Evaluation and Analysis - The S&J solar cell module surveillance retest schedule for the entire 18 months surveillance period was completed and submitted to S&E-ASTR-EPN on July 22. Selection of Spectrolab modules for the joint surveillance test is underway.

Changes were recommended in the retesting of the ATM solar modules due to the initiation of the Spectrolab solar module thermal bakeout test. These changes were submitted to S&E-ASTR-EPN on July 22. The changes contained joint S&J and Spectrolab testing but separated data reduction by manufacturer.

Evaluation of the July surveillance sample is underway.

A method was presented to S&E-ASTR-EPN on July 22 by which the degradation of solar module electrical parameters might be determined statistically.

TD 13 Phase II SNAP 19 Thermal Vacuum Test - Total test time for SNAP 19, S/N 19, as 18,621 hours at midnight July 31. Of this figure, 12,970 hours testing have occurred at MSFC.

Present plans call for terminating the vacuum soak test at 3,000 hours on September 9. At this point powered operation will cease, and the SNAP will be prepared for the materials analysis test phase.

A progress report for the month of July is being prepared and distribution is expected on August 4.

Operation is continuing satisfactorily and testing is on schedule.

TD 14-1 AAP Flight Equipment Design - The power transfer distributor design specification, scheduled for completion by August 1, was completed on July 3.

Two special purpose printed circuit boards were designed at the request of S&E-ASTR-EBF and pin function data were delivered on July 1.

Mechanical design packages for the main power distributor, auxiliary power distributor, power transfer distributor, controls and displays (C&D) logic distributor, transfer assembly, and watt-hour assembly were received from the off-site checking unit on July 1. A review and/or incorporation of recommended drawing changes has been initiated.

A preliminary transfer assembly structures and dynamic analysis was received from Sperry Utah on July 2 and submitted to S&E-ASTR-EAA on July 9. A review of recommendations was conducted on July 10 and design modification sketches mailed to Sperry Utah on July 11 for comment. Concurrence with the design modification was received by telephone on July 18.

A preliminary main power distributor thermal evaluation was received from the Sperry effort in support of S&E-ASTR-MA on July 23. A review of comments and recommendations has been initiated.

Design specifications and mechanical outline drawings for all ATM electronic assemblies designed to date were submitted to S&E-ASTR-EAA on July 24 for review.

One Sperry mechanical designer accompanied S&E-ME-WD personnel during a visit to Fred D. Wright, Inc. of Nashville, Tennessee on July 25. The purpose of the visit was to inspect sand castings to be used as ATM flight hardware prior to approval of machining operations.

TD 15-1 ATM Special Circuits Design - The watt-hour assembly multiplier circuit was redesigned using an operational amplifier oscillator. Temperature testing of the new configuration is nearing completion.

Sprague 137D capacitors were placed on order in compliance with quality control recommendations. The TLW Mallory capacitor was reordered with an expected October delivery.

The final design configuration of a five second timer was submitted to S&E-ASTR-EAA on July 8, with approval obtained on July 15. An engineering model test plan is complete, pending the establishment of special test unit pin functions.

An effort to standardize the printed circuit board configuration of one second, five second and 10-minute timers has been initiated. A new 10-minute timer engineering model is under development in compliance with the modified design philosophy.

A current sensor engineering model was found to hold three percent accuracy over the entire range of temperature testing. The requirement is 10 percent.

An investigation of the isolated logic amplifier has revealed that this circuit, with some modification, will meet the requirements of an AS&E alert indications voltage level detector. Laboratory circuit development has been initiated.

TD 16-1 AAP Flight Equipment Documentation Development - The power transfer distributor qualification test specifications/procedures were completed on July 3.

A draft of the auxiliary power distributor qualification test wiring list was delivered to S&E-ASTR-EAA on July 24. The typing of a final document was initiated on July 25.

The development of acceptance test specifications/procedures for all ATM electronic assemblies designed to date is 75 percent complete.

Transfer assembly qualification test wiring lists and electrical schematics are 90 percent complete. A study has been initiated to determine the quantity of transfer assembly documentation that may be directly applicable to the controls and displays (C&D) logic distributor requirements.

A connector to terminal point qualification test wiring list for the power transfer distributor is available in draft form. Progress in completion of the list and associated electrical schematics is dependent upon the timely resolution of a proposal to change connector requirements on the unit.

TD 21 ATM Networks System Design - The effort on system schematic generation and redesign is continuing in preparation for the scheduled CDR. Thirty-three new and 264 revised sheets of system schematics have been delivered to off-site drafting. A total of 491 sheets have been completed to date.

ECR ADS-16 was written to reduce the number of J-Boxes.

ECR ADS-17 was written to update the CID, 40M33651.

The power profile computer data cards have been updated to correspond to the ATM Equipment List, Revision "B". An updated ATM power profile will be completed upon receipt of plots from the S&E-COMP- Laboratory.

The generation of distributor and cable wire lists is continuing. The auxiliary power distributor and control distributor No. 1 are in typing. Cable wire lists for 703, 710, 711, 712 and 713 have been typed.

One IRN has been submitted against the H-alpha 1/H-alpha 2 ICD, 40M34488.

Engineering inputs for ESE umbilical and carry-on ICD are being generated. Inputs for the LM-A ICD are being generated as required.

The dry workshop concept will affect the ATM networks design, but the magnitude of the changes required is not known at the present time. All system schematic effort and circuit design effort which would require interfacing with the LM-A has been halted until further definition of the necessary changes is received.

TD 24 Circuit Protective Device Evaluation and Testing - Testing on the Mechanical Products circuit breaker is continuing. Testing of the Bussman 30-ampere fuses is proceeding on schedule.

TD 25 Relay Testing and Evaluation - Testing has been completed on four Potter and Brumfield relay sets: SCV 7000, SCV 7001, SLV 7004, and SLV 7005; and on the General Electric 3SAV1421A2 relays.

Tests of the C. P. Clare PF1111L01 have been delayed because of excessive vibration failures and the relays returned to the manufacturer. Testing of the Electrotech 600-02 was suspended because of numerous failures in life test. Ten Webco H35EK4HX2 relays were run 100,000 cycles of life test to ascertain that the equipment was not defective. The Electrotech relays were returned to the manufacturer.

The C. P. Clare HSW1117K01 testing is continuing with life test completed. Testing has been initiated on the C. P. Clare TO-5 relays. Five relay sets have been completed and two are in process.

An "E" revision to the relay specification, 40M37496, has been typed, and only minor corrections to the drawings remain to be done before release. The E-size drawing, 40M37907, has been released.

TD 27 ATM Solar Cell Module (SCM) Diode Characteristics - Thermal hot spot tests, as outlined in a preliminary test plan, were performed on two 1 cm by 30 cm Westinghouse solar cells. Copper-constantan thermocouples were used to monitor the temperature at six locations along the length of the solar cell. Preliminary results of the post-test analysis indicate that additional tests are required to further analyze the solar cell response. Arrangements have been made to perform a liquid crystal test, and possibly the infrared scanning test, to further analyze the solar cell hot spots.

TD 28 ATM Solar Cell Array Electrical Checkout - A meeting was held with representatives from General Electric to brief them on the planned checkout of the ATM solar cell array. Electrical test and checkout objectives for the array that was delivered June 16 remains under review by S&E-ASTR-EPN personnel.

Equipment design for the illumination test has been delayed pending further investigation of light sources. However, a purchase requisition for G. E. Lucalox lamps has been approved and is being processed. Also to be considered for this application is a long-arc 20kw cone fixture supplied by the Xenotich Corp. of Van Nuys, California. Further information on this system is expected shortly.

TD 29 ATM and OWS Solar Power System Tests - Further discussions were held with Martin-Denver personnel on July 9 concerning solar cell modules and the panel frame to be used in sunlight tests. A decision was made that connections to the actual flight modules would not be soldered; therefore, a satisfactory temporary connector device will have to be developed.

The tracking pedestal, trailer, and test panel frame were moved to building 4656 for wiring and checkout prior to shipment to Denver. Panel-to-CBRM cable fabrication has been completed and the panel wiring harness fabrication is in process.

This effort is behind schedule because higher priorities delayed fabrication of the test frame.

TD 30 Thermal-Electrical Energy Conversion Study - Difficulties are still being encountered in running and debugging "ELOADS", the load analysis program. Subroutines PLOTMY, LT, PISTUG, and KHAR are operational, but the main program, subroutine putout, and the assembled program still have undetermined flaws. Turnaround times of greater than one day greatly increase the time to resolve these problems.

Liaison is being conducted with Sandia Corp., the AEC's agent managing the radioisotope thermoelectric generator programs, and Isotopes, Inc., manufacturers of SNAP 19 for information and services necessary to conduct a post-test analysis of SNAP 19, serial No. 19. Recommendations are being prepared for areas of emphasis and procedures in the proposed analysis. The analysis is scheduled to begin as soon as possible after termination of current testing on September 9.

The FSS-reactor thermoelectric power system integration study was terminated on July 9 with a final review briefing to NASA-MSFC management. Presentation materials were made for this briefing.

TD 32 New Technology Solar Module Test Program - Post acoustic noise checks showed that no electrical performance or physical degradation resulted from acoustic tests performed on the TRW arrays. A preliminary copy of the environmental test report for the three engineering test models was sent to TRW on July 8.

Shock tests, which are the only remaining tests to be performed on the arrays, are currently being scheduled to be conducted at Wyle Labs.

Test facility scheduling and setup problems have delayed completion of this effort.

TD 33 ATM Ni-Cd Cell Limiting Characteristics - Design and fabrication of the control and monitoring equipment is 60 percent complete, and test procedures are being prepared. The test specimen delivery date has not been established.

TD 34-1 Infrared Cage Support - The infrared cage controller configuration remains the most significant hardware question to be resolved. Testing of a silicon controlled rectifier device under radio frequency interference is tentatively scheduled to begin on July 30. A test plan is being developed in coordination with facility personnel.

The development of a cable interconnect diagram has been initiated. Equipment location, necessary to cable lengths, has not been established.

TD 37 ATM SCM Thermal Vacuum Conditioning - Over 70 percent of the solar cell modules have been baked out to eliminate the possibility of later outgassing problems. This task should be completed during the next reporting period.

II. STAFFING

An average of 66 permanent employees and 2 temporary summer employees supported this appendix in July.

July, 1969

APPENDIX G-1

INERTIAL SENSORS AND STABILIZERS

I. TECHNICAL PROGRESS AND ACCOMPLISHMENTS

Schedule Order 207

Integration and Flight Qualification Branch

TD-3 Optical Alignment - Modification of a Theodolite Calibrator (remote angle generator) was completed. Realignment of the unit is being performed.

Modification of the Leitz head base in Room AA-115-2 was completed. The head was relevelled and realigned.

Optical alignment of the SD-53 platform was performed for post sled test evaluation.

A description and a stability study of the Astrionics azimuth reference system was made.

A North-South reference line was determined for location of anchor bolts for the installation of an Inland Controls rate table in Room AA-115-2.

A study is being performed of a proposed method to determine longitude and latitude of an observer by measuring the change in location of a star or the sun in a given time increment.

TD-4 Sun Sensor and Star Tracker Equipment - All the basic circuits of the digital logic unit (DLU) except the Binary - BCD converter have been functionally checked.

A test panel is under construction that will simulate a gimbal output. The test panel will be utilized to check out the DLU as a functioning unit.

A functional check is being performed on the Binary - BCD converter (DLU) and the binary up-down counter (test panel).

TD-6 Saturn V Platform and Control Moment Gyro (CMG) Evaluation - CMG S/N 0001 was functionally tested with a revised test procedure. Some discrepancies were noted in the test procedure. CMG S/N 0002 will be tested next period.

Based on the performance of AS-506 and revised requirements from MSC, the test procedure specification for KSC IU checkout is being reviewed to see which requirements can be relaxed.

TD-7 Slip Ring Testing and Assembly of Fine Sun Sensor - Life testing of the following slip rings was completed: DP1501 S/N's 61, 58, DP1506 S/N's 149 and 172. The following slip rings were placed on life tests: DP1506 S/N's 180, 196, 201 and 203.

Circuit modifications and design changes were made in the fine sun sensor control electronics.

TD-14 Design and Checkout of Test Equipment - Hoist design is continuing. Manufacture and assembly is scheduled to begin next period.

Sensors Branch

TD-1 Inertial Sensors Development and Evaluation - Tests were completed on the SD 53 for post sled test evaluation.

A console for performing ATM gyro demodulator linearity tests was modified and checked out. Linearity tests were performed on ATM gyro's S/N's 001, 102, 103, 104, 105 and 106.

All ATM rate gyro P.C. cards have been checked out. The heater control modules did not meet vendor specifications as regards heater current which measured high. The test setup is being checked to determine if the current drain is high due to the instrumentation or to the module design.

A limit cycling instability was traced to the torquer amplifier and corrected by changing a capacitor in the roll-off network. During demodulator calibration tests a high noise level of five to eight times specification limit was observed. This discrepancy has not been resolved. The mounting base flatness was found to be significantly out of tolerance on all packages, apparently due to distortion introduced by the internal EMI shield.

TD-2 Test and Evaluation of Exotic Inertial Components - A test setup utilizing a laser interferometry measuring system and an Ideal-Aerosmith tilt meter was made. Purpose of this arrangement is to eliminate the errors due to accelerometer fixture distortion caused by temperature changes.

TD-8 Testing and Assembly of Inertial Components - Testing of Mechanical Technology Incorporated helical spring compressor, three CMG bearing life test, and gyro bearing life test were continued.

TD-9 Experiment Number 11 Package - Functional evaluation of unit number two of the Wayne-Kerr displacement electronics was completed. The unit was packaged and stored for use at a later date. TD was closed June 30.

TD-11 Heat Pipe Research and Development - The 3/4 by 24 inch heat pipe was filled with ethanol. Tests performed indicated that the ethanol was not a good working fluid. The heat pipe will be refilled with distilled water and tested. Purpose of this test is to determine with what accuracy a heat pipe can be reproduced. Additional tests planned are to fill the heat pipe with varied amounts of water to determine how the amount of water affects efficiency.

TD-12 CMG Inner Gimbal Assembly Testing - Power supply instruction manual and specification were reviewed and discrepancies noted. The test stand for the second CMG-IG test station has not been delivered. An investigation is underway to determine the cause of erratic phase current readings in the prototype CMG-IG.

Advanced Research and Technology Branch

TD-13 Optical Sensors Test and Evaluation - The breadboard heliostat electronics is being modified, checked out, and packaged. The circuit schematics are being updated.

TD-16 OWS Articulation Control Electronics - The system block diagram was updated and redundancy circuits added. A preliminary description of the system was written.

TD-17 LRV Steering Control - A study of the steering control requirements and methods of steering the Lunar Roving Vehicle was initiated.

Control Mechanisms Branch

TD-15 Simulation and Analysis of ATM EPC/RPM Control System and S-IV-B Solar Panel Actuator - Analog simulation and Root Locus analysis of the ATM experiment pointing control system with various parameters and conditions were made.

II. STAFFING

The appendix is being supported by the authorized level of 19 people.

July, 1969

APPENDIX H-1

PROTOTYPE DEVELOPMENT BRANCH

I. TECHNICAL PROGRESS AND ACCOMPLISHMENTS

Schedule Order 208

TD 1 Beryllium Anodizing - Editing and resulting revisions to the report were completed during the month. The report has been delivered for review.

TD 6 Report-Testing Flat Cable and Connectors - No activity. No change in status from previous month.

TD 7 Design Flat Cable/Plug Flexure Test Fixture - No activity. No change in status from previous month.

TD 9 Revisions to Flat Cable Information Book - There was no activity because of the higher priority assigned to TD 19.

TD 17 Qualification Test Procedure for Junction Box PM 11514 - Minor revisions were incorporated during the month and copies of the new draft were delivered for review.

TD 19 Design Documentation - OWS Solar Array Flat Cable System

Hardware - The status of this TD at the end of July is as follows:

- | | |
|---------|--|
| Item 1 | Junction box - All drawings are complete and checked except the printed circuits and associated assemblies. These drawings are scheduled for completion during the first week of August. |
| Item 2 | FCC Cable - Complete |
| Item 3 | Junction Box Connectors - Complete except for one-inch plug which has been revised and is ready for checking. |
| Item 4 | Edge Module Connector - The 50 M drawings are checked and ready for release. |
| Item 5 | Module Connector Bus - The 50 M drawings are checked and ready for release. |
| Item 6 | Module Edge Fairing Insert - The 50 M drawings are checked and ready for release. |
| Item 7 | Cable Tie Down Hardware - Initial studies have been made. |
| Item 8 | Harness Assemblies - Study layout for cable locations on back of solar panels is being made. |
| Item 9 | Two Inch Receptacle/Solder Terminals - Not started. This item covers conversion of PM design to 50 M format. |
| Item 10 | Two Inch Plug/5 Cables - In process. |

TD 20 Engineering Tests - Junction Box PM11514 - No activity.

TD 21 Reports - Engineering Evaluation Tests - All test data received to date have been added to the drafts previously prepared.

TD 22 Design-Miscellaneous - There were no work orders issued during July.

TD 23 Revisions to Procedures for Hybrid Circuits - Study work was performed resulting in a proposed outline. The rewriting of section 6 of the present document was in process during the first week of the month. At that point we were requested to stop work on this TD in order to proceed with a new TD 25.

TD 24 Study Etch-Back Techniques - Multilayers Printed Circuit Boards - A study of glass versus epoxy ratios for various board materials has been completed. Etching solutions were prepared and used on sample single layer boards with satisfactory results. Continuing work on this project includes analysis of results and performing etching runs on holes drilled in multilayer boards. It is anticipated that this project will be completed and the report issued during August.

TD 25 Reports - Flat Cable Summary and FCC Adhesives - The initial draft of the Flat Cable Summary report is well under way, the section on historical background is near completion. The purpose of the report is to present a brief review of the general status of the overall flat cable program.

The report on adhesives recommended for flat cable installations has not been started because of limited manpower.

II. STAFFING

The section remains fully staffed with six employees.

APPENDIX I-1

INSTRUMENTATION AND COMMUNICATIONS DIVISION

I. TECHNICAL PROGRESS AND ACCOMPLISHMENTS Schedule Order 209

Imaging Branch (IP)

TD 209-1 ATM Vidicon and Low-Light-Level (LLL) Television Camera Systems - The NRL flight prototype LLL camera system was completed and delivered for final quality inspection on July 25. Assembly of the HAO flight prototype LLL TV camera progressed as follows: Preliminary electrical checkout of all P.C. cards was completed and the camera harness installed. The motherboard was checked, conformally coated, and installed in the camera control housing. The low voltage power assembly and checkout progressed to 90 percent completion. The LLL tube was installed in the deflection assembly, checked out, and sent to final potting.

Cold case thermal vacuum qualification testing of the vidicon camera qualification model was successfully completed. Facilities are presently not available for outgassing testing.

The NRL EM No.2 LLL camera was returned for rework because of excessive outgassing and various other minor problems. The wire (MIL-W-81044 type) used to build the camera harness was found to be unsuitable for use even though it was listed in 85M02716, the ATM approved parts listing. The harness was removed from the camera and replaced with one constructed of teflon-coated, nickle-plated copper wire. The misalignment of approximately five degrees on the rotation of the LLL tube in the camera box was not corrected because of the danger of possible tube breakage, but the method of aligning the camera was changed to prevent recurrence of this problem. The horizontal scan direction was reversed to conform with the latest request.

Two problems were discovered during the month and are presently under investigation.

(1) During temperature acceptance testing of the NRL flight prototype LLL camera the Interelectronics high voltage power supply failed at -26°C. Two other units have since been tested and have also failed. This problem could have significant impact on future flight deliveries.

(2) Ball Brothers Research Corp. has detected outgassing products similar to "Loctite" coming from the NRL EM No. 2 LLL camera. No "Loctite" is used in the camera, and, therefore, this is very puzzling. The red ink used to mark the locking helicoils used in the camera housing has never been tested for outgassing characteristics and at present is a likely candidate for the source of contamination. The ink is presently in testing.

TD 209-2 Final Alignment and Acceptance Testing of Flight ATM Television and Video Switches - The video switch performance specification, 50M12736, was revised to incorporate changes and to correct errors.

Additions and changes to the video switch checkout procedure required further changes to the qualification test specification/procedure, and acceptance test specification/procedure which are in process.

Orders were placed for flight PC cards M7988B, M7989A, and M7990B. The printed wiring master print of M7847F, 50M12876, was damaged in TDs and requires repair and re-release. Minor circuit changes were made to M7847F switching circuit to meet input and output impedance requirements. No board changes were required.

TD 209-3 ATM Sync Generator Design Development and Qualification - Assembly and checkout of the qualification model sync generator continued. The unit should be completed by September 15. Final copies of the acceptance and qualification test procedures were reviewed.

TD 209-16 H-Alpha Film Camera Design Development - The qualification model camera S/N 306 was delivered from S&E-ME Laboratory. This camera will be functionally tested at MSFC (also environmentally, test time permitting) prior to shipment to Perkin Elmer Corporation on September 2. Both the mechanical and electrical designs for the camera were presented at the critical design review (CDR) for H-alpha at Perkin Elmer. Camera S/N 204, proposed for use at Rye Canyon by Perkin Elmer later this summer, was on display. The electronic control box for this camera has been built and will be shipped to Perkin Elmer by mid-August. Extensive shutter testing is presently in process to establish the 1/125 second shutter speed required; these tests include a life test with consistent shutter speed.

TD 209-17 Goddard X-Ray Film Camera Design Development - The X-ray testing at Martin-Denver is now in process and X-ray images have been made. The qualification testing on S/N 202 is still in process. In conjunction with the qualification model telescope, the test plan called for camera operations every ten orbits. This was changed and the camera was run in the full automatic mode for five consecutive orbits in both the hot case and medium case test conditions. Vacuum film testing has been completed on two one-thousand-foot rolls of SO-114 film. The results of the first thousand-foot roll show no signs of the static reported in last month's progress report. The second roll is presently being processed. The major portion of the design effort on the GSFC camera is presently devoted to the forthcoming X-ray optical testing of the telescope and camera. These tests require several fixtures to be designed and fabricated prior to commencement.

Communications and Tracking Branch (IR)

TD 209-4 Pre-Flight and Post-Flight Radio Frequency Data Analysis - A report documenting the results of the TV Broadcast Satellite study and the associated computer programs was completed. Adaptation of the Network Analysis for Systems Applications Program (NASAP) for use on the IBM 1130 was completed. Similar efforts were started to adapt another version of the program to the 1108 computer. Work has begun on generation of a program for computer assisted circuit design to utilize the IBM 1130/2250 graphical display. A rudimentary optical computer was developed using available equipment, and laser reconstruction of computer generated Fourier transforms was demonstrated. An elementary graphics program was generated (based on a Univac example program). Efforts are presently being made to get computer time for the Univac Advanced Graphics Unit to test the program and the device.

TD 209-5 Electro-Magnetic Interference (EMI) and Transient Testing and Electro-Magnetic Control (EMC) Functions - This TD was terminated effective July 19, as a result of Astrionics organizational realignment.

The effort assigned under this TD will be continued under TD 202-6003 issued by Electro-Mechanical Engineering Division. During July the following tests were performed: developmental tests in accordance with MIL-I-6181D on the prototype DC/DC converter, ASTR-design and on the simulated S1W solar array cabling. Transient tests in accordance with 50M02477 on the fine sun sensor power supply (breadboard) were also performed. All units met test objectives.

TD 209-7 Assembly and Testing of One-Tenth Scale Model Antennas for the ATM/OWS - One-tenth scale model antenna patterns for the model 231 TM antenna and the telemetry antenna on the model 316 antenna panel were delivered to Sperry off-site for inclusion in the antenna book. A complete set of model antenna patterns was run on the command antenna on the model 316 antenna panel but the data were degraded by an erratic power source and are being rerun. One-tenth scale models of the airlock ranging stub antenna and LM quadfilax helix were built and installed.

TD 209-8 ATM Tests and Hardware - The specification, acceptance test procedure, and qualification test procedure were reviewed and corrected for the model 240 RF coupler. The model 240 RF coupler drawings were completed and released to documentation. Specification information on all ATM antenna components for the quality control review were collected. A Microdot power oscillator was repaired for use during environmental testing of the model 240 RF coupler.

TD 209-9 Automatic Gain Control System Design - An AGC amplifier was built for insertion in a crystal bolometer amplifier. A 12-volt regulator for AGC amplifier and a hold circuit for AGC level were designed and built. A zero inertia level sampler was designed, and work commenced on a variable sensitivity comparator.

Measuring Instrumentation Branch (IM)

TD 209-18 Orbital Workshop (OWS) Biomedical Electronics - TD 18 was revised to reflect new milestones and manpower requirements for a metabolic measuring concept comprising three modes of operation instead of one. Parts ordered for the original design were received and are being used to build the first breadboard which is 30 percent complete. Parts for a second breadboard are on order.

The time-base generator portion of the electronics has been designed. The circuit will be refined and incorporated into the system during the next reporting period.

TD 209-19 X-Ray Telescope (X-RT) Design Development - The qualification test model X-RT (S/N001) is being tested in the thermal vacuum chamber. The hot, cold, and mean temperature cases as specified in the qualification test plan were run. The temperature of the forward, center,

and aft tubes of the X-RT was controlled at $70^{\circ} \pm 0.1^{\circ} \text{F}$ for both the primary and secondary heater systems. Layouts of an optical bench to mount two telescopes back-to-back for X-ray focal plane determination have been completed. Preliminary drawings of the details are being made. The display model X-RT (S/N AL3) has been assembled with the MSFC fused silica optics and has been delivered for optical testing. The "A" frame has been received for use in the cleanroom. Modifications to raise the height of the "A" frame are in manufacturing. Miscellaneous lifting hardware has been ordered for the cleanroom.

TD 209-20 ATM Experiment S-056 Electronics Design Development

X-REA - The detent and spring mechanism will be eliminated from the aperture wheel assembly. This decision was based on results of an aperture alignment test. Drawings for the +5v power supply, charge sensitive amplifier, and high voltage power supply are to be delivered by August 6 for engineering review. Receipt of these drawings will complete the electrical drawing requirements for the X-REA. A holder for X-ray tubes was manufactured and assembled for possible use during qualification testing of the X-REA. Mechanical specifications for the aperture motor and mounting assembly were reviewed for accuracy of technical content. A life test was initiated on reed switches in the aperture wheel assembly.

Camera Electronics - Four P.C. boards for the Goddard camera have been manufactured, inspected, and returned to the shop for subassembly build: Parts have been assembled on the film-airlock motor control one-shot and the exposure timer control board. Testing of these boards will be completed during the next reporting period. The timer and lamp power supply drawings were checked and returned to design.

TD 209-21 H-Alpha Camera Electronics Design Development - The camera ready operate module, the motor drive, and the power supply have been satisfactorily tested over the required temperature range.

A critical design review presentation was prepared and given at Perkin Elmer. The control electronics and the motor drive board have been fabricated; test of the control and the data block electronics have begun. The assembly of the engineering model H-alpha camera electronics system is also complete and testing has commenced. Class I documentation for the H-alpha motor drive has not been received; therefore, delivery of a qualification unit by September 1 may not be possible.

TD 209-28 Engineering Model Solar Reflectometer - The optical system was aligned but no data were obtained due to a severe noise problem. It is problematical whether suitable results can be obtained without repackaging or redesigning part of the power supply unit. The investigation of this problem will continue on a low priority basis.

Telemetry and Data Technology Branch (IT)

TD 209-11 Telemetry Ground Station Operation and Maintenance - Special timing signals were recorded on magnetic tape for use by personnel in S&E-ASTR-IME. The ground station was prepared for the AS-506 launch, and the

launch and two orbits were recorded. A new time control unit, built by Sperry off-site, is being evaluated. New cables are being installed for the monitor system and the Elpac synchronizer; this will enable switching from one to another through the patch panel.

TD 209-12 ATM Digital Signal Conditioner (DSC) Design Development - All P.C. board drawings have been delivered to the shop for manufacturing. Unscreened components for use on the DSC engineering model are now being collected. Work on the test box for checking the contents of the registers in the DSC is continuing. Signal specifications for the DSC are now being finalized. The original design of the DSC proved to be well within specifications and virtually no changes were required.

TD 209-13 Saturn Telemetry Design Maintenance - A report was completed describing experimental procedures for measuring waveform distortion resulting from channel filters in Saturn telemetry hardware. Two techniques were analyzed, one involving the use of the TDAS (Telemetry Data Analysis System) and the other being the so-called Shepertychi approach. A formal report was completed in which errors resulting from nonlinearities in low-pass channel filters are analyzed. One 301 PCM/DDAS assembly and one model 410 RDM were repaired and returned to S-V-LC39/ML1-ESE MON. Fourteen miscellaneous printed circuit cards from 301's and 410's were repaired and are available for lab use. Two analog-to-digital converters (model ADC-4), used in the 301, were repaired and are available for lab use.

TD 209-14 ATM Digital Tape Recorders - Acceptance test was performed on the Borg Warner prototype tape recorder at minus 20 degrees. The recorder failed to respond to the end of tape sensors and the tape broke. It was discovered that the vendor had not followed the test procedures for selecting resistors in the end-of-tape sensing circuit. After correcting this problem, the tape recorder has successfully completed the cold temperature test. Leak rate test is scheduled to be performed August 1. Humidity and thermal vacuum testing is scheduled to be performed on the prototype recorder by mid-August.

TD 209-15 Telemetry RF Components and Systems Support for Saturn, ATM, and AAP - The PCM transmitter response study is continuing. Most of the work being done at this time involves correlation of experimental data and theoretical results.

The Teledyne X9 multiplier qualification unit was received and put through all temperature tests. The unit performed within the specifications on these tests.

TD 209-22 Support Design and Development of ATM and AAP DC-DC Converters - No effort was expended on this TD during July.

APPENDIX K-1

SYSTEMS DIVISION

I. TECHNICAL PROGRESS AND ACCOMPLISHMENTS
Schedule Order 227

Guidance and Control Systems Branch

TD 1553 Orbital Workshop System Simulation/Integration Development - A report covering the status of the wet OWS verification models on the Raytheon 520/EAL 231 RV hybrid facility was furnished SE-ASTR-SGI. This report outlined the significant facility down time problems which have slowed program development and checkout, and indicated that the present computer capacity is not sufficient to accommodate the entire wet OWS model. It was decided to terminate activities with respect to wet OWS model verification and to devote all future efforts to dry workshop modelling and hardware system verification plans. Those portions of the wet model applicable to dry OWS will be retained.

TD 1554 - ATM DC Software Program Verification Plan - Requirements for the input/output equipment necessary to interface with the test computer have been established. The input/output scheme (discretes, interrupts, telemetry, etc.) is being reviewed in detail to establish a test philosophy. The capability recommended for incorporation in the ATM DC software package for test and verification purposes was furnished S&E-ASTR-NGI by memorandum. Familiarization study of the ATM pointing control system and its operational modes was continued.

TD 1555 AS507 Flight Program Verification - The AS-507 Generalized Flight Program (GFP) has been run some 150 times in simulated flight through S-IVBE first burn. These flights have included system perturbations to verify the following areas of GFP computation: (1) platform readout, (2) discrete processing, (3) switch selector processing, (4) engine performance and (5) navigation. Data from these runs are organized and tabulated for analysis. To date no program deviations or anomalies have been observed.

Modification to the PTC simulation support program were necessary to properly interface the GFP telemetry. Further programming effort is in process to enable the use of the LVDC preflight routines. The LVDC sector sum check and memory dump programming for the PTC is in the process of checkout.

TD 1556 Interface between Sigma 5/Comcor 5000 and ASTEC - Other than general review, no effort was expended on this TD during the month. Information for the wiring interface has been furnished S&E-ASTR-CS. Software requirements for the vehicle simulation have also been generally defined but not detailed.

Vehicle Dynamics Branch

TD 1501 WACS Control System Dynamic Analysis - System time response studies with flexible body dynamics have been completed for the pitch axis. The response data were obtained for various hypothetical bending parameters such as frequency, damping, and gain. Phase-plane plots of attitude rate versus attitude error were also obtained for the inertial hold mode. Transmittal of these data to the technical contact will complete the requirements for this technical directive.

TD 1502 Analytic Assistance for Nyquist Program Development - S&E-COMP personnel have resolved the problem associated with the leading coefficient of the polynomial in Z, as computed in the Z plane Nyquist program. Debugging is being continued, however, to determine the source of error associated with the regenerated polynomial in Z.

TD 1503 Saturn V, S-II and S-IV B Stage Dynamics Analysis - Preliminary logic flow diagrams generated by the simulation support personnel will be reviewed as soon as they are made available. The slosh data for the S-II stage presently being prepared are the last of the data to be delivered for simulation input.

TD 1505 Crew Motion Model Study - Results of the RAVAN stationarity tests were received from S&E-COMP Laboratory for the three sample cases submitted. Plots of these results and similar results obtained from the modified PSD program via the fast fourier transform were delivered to the technical contact. Both plots indicated deviations from expected values and the cause of the differences has not been determined. The requirements for additional study in this area will be considered in a meeting with the technical contact during the next report period.

TD 1506 EPC Stability and Response Analysis - Analysis of the recently released bending data for the EPC spar is in process. Preliminary results indicate that the modal slopes at the rate gyro location are not negligible. The new data will be incorporated in both the digital and analog EPC models for continued study of stability and response characteristics. An analog simulation of the two-axis model has been completed and will be used for further studies of the cross-coupling effects due to the bending dynamics.

The difference in results obtained with the 11x11 and 35x35 matrix expansion programs has not yet been resolved, and additional test cases are being submitted for further study.

TD 1507 SMC Interaction Study - The SMC interaction study has been completed and a report of the results is documented in report SP-591-0240. Distribution of the report is in process, which completes the requirements of this TD.

TD 1508 Saturn V, AS-505/SI-C Stability Analysis - An analysis of the stability characteristics of the AS-505/SI-C vehicle has been completed. Distribution of the final report, #SP-591-0236, completes the requirements of this technical directive.

TD 1509 Sampled Data Analysis Program - Program # YMSF-371090 has been modified and is running satisfactorily on the S&E-COMP 7094 computer. The four test cases supplied by North American Rockwell were run, and the results compared favorably with the results obtained at their computer facilities. The program is now being converted for operation on the Univac 1108 facility, and additional subroutines are being added to increase the utility of the program. In accordance with a request by the technical contact, a users manual which is applicable to both the 7094 and the 1108 facilities will be prepared at a later date. This completes the requirements of this technical directive.

TD 1510 Computation Laboratory Interface - Routine interface liaison was maintained with the Computation Laboratory in connection with S&E-ASTR-SD technical directives.

TD 1511 Visual Information Preparation - Publications support was provided for reports "Detailed Implementation of the Momentum Management Scheme for the ATM Cluster", "Effects of Momentum Distribution on the H-vector Control Torque Transfer Function", and "Stability Analysis of AS-505/S-IC". An ATM Cluster composite drawing was made. A master form for display of S-IC strip chart data was drawn and 60 copies made.

TD 1513 CMG/H-Vector Modeling and Analysis - A report No. SP 591-0238 documenting the analytical evaluation of cross-axis gain for various gimbal angle configurations has been distributed. Effects of the CMG reorientation and the status of the CMG gear test program have been reviewed and reported. This completes the requirements of this technical directive as scheduled.

TD 1514 Saturn V/SI-C Hybrid Simulation Studies - Required support was provided for the preflight activities of the SI-C/506G vehicle. A study is in process which compares the telemetry data with the simulated flight data obtained from the hybrid simulation model. Documentation of the results will be prepared during the next report period.

TD 1515 AS-506 Stability Analysis - A comparison of stability data obtained for two similar trajectories of the AS-506/SI-C vehicle is in process. Additional studies also include a stability analysis of the S-II and S-IVB vehicles for critical times of flight. Results of the study will provide guidelines for the preparation and utilization of computer programs for preflight analysis of the AS-507 vehicle.

TD 1516 APS Attitude Control System Stability Analysis - An analog simulation model of the APS control system has been developed. The model includes rigid body dynamics for pitch yaw and roll, flexible body dynamics for four torsion modes, and the non-linear characteristics of the three pseudo-rate modulators. Phase plane plots of the vehicle attitude rate versus vehicle attitude error have been obtained. Studies are in process to determine system response to various input disturbances, and a fuel consumption equation is being programmed. Additional studies of vehicle stability and response will be conducted.

TD 1517 Digital Control System Design for the Saturn V - Work on this technical directive has just begun. Data are being prepared in the proper format for input to the 35x35 expansion program for the purpose of obtaining uncompensated frequency response data.

TD 1518 Digital Control System Design for the ATM/CMG System - Preliminary frequency response data have been obtained for the H-vector loop. The F*S program was utilized to model the continuous system plus a zero order hold for various sampling frequencies. Preliminary frequency and time response data were also obtained for the EPC loop model with a lead-lag compensator which was simulated on the PB-250 computer. The EPC dynamics were simulated on an AD-112 analog computer. The data are being used to check the accuracy and operation of existing sampled-data computer programs. These computer programs will be used for the design and analysis of the ATM/CMG digital controller.

TD 1519-AS-507 Stability Analysis - Work on this task was initiated. Bending data and the control network polynomials are being prepared for input to the 18x18 driver matrix program. Nyquist plots of the control loop open at the engine, rate channel, and attitude channel will be obtained at the critical times of flight.

Electrical Systems Branch

TD 1561 ESE ICD-IRN Processing - Twelve new or revised IRN's/ICD's were received by S&E-ASTR-SE. Twelve IRN's/ICD's were processed and four IRN's/ICD's were submitted to Projects Office, S&E-ASTR-BE.

TD 1562 Reference Schematic Maintenance - This TD was closed on July 15. During this report period, no effort had been expended to the closing date. Necessary maintenance of the reference schematics will be accomplished under S.O. 227, TD 1569.

TD 1563 EDS Documentation - IRN R31 to 4QM37559B was prepared and released.

TD 1564 EDS Simulators Maintenance - Weekly operational and maintenance checks were performed on the Saturn V Simulator. An operational check was performed on the Saturn IB Simulator on July 22. Power supply No. 1 malfunctioned (no regulation high voltage). Repairs will be effected if a requirement for the system develops.

TD 1565 Stage Networks Integration - One S-IB ECP, three S-II ECP's, and three S-IVB ECP's were reviewed for compatibility. Documentation for S-IB, S-IC, S-II, and S-IVB was reviewed and updated.

TD 1566 AAP Networks Integration - Electrical ICD's for experiments M092, M131, and M171, as well as for the LM-A/MDA interface 40M35597, were reviewed and comments were delivered. AAP-2 experiments correspondence was received and reviewed for impact. A meeting was attended during which the experiment support system electrical ICD and requirements for experiment electrical ICD's in general were discussed.

TD 1567 Saturn Flight Sequence ICD Generation and Maintenance - One IRN and one ECR were generated against ICD 40M33627, Definition of Saturn SA-507 and Subs Flight Sequence Program.

TD 1568 Document Control Center - This TD was closed on July 15. The preparation of the EICD Status Report will be performed under SO TD 227/1569.

TD 1569 Electrical Interface Control Documentation - Seven Saturn/Apollo IRN's were initiated and five Saturn/Apollo IRN's were completed. ICD 40M30597 is being revised for release in September. The S-IVB Control Drawing Status Report was prepared and delivered. Sketches, Vu-Graphs, and copies were prepared for S&E-ASTR-SEC in preparation for the 10th Electrical Panel Meeting.

A meeting was held with Mr. A. P. Woosley, S&E-ASTR-SEC, to discuss changing the S-IVB/Solar Array from the wet workshop to the dry workshop configuration. A preliminary ICD (dry workshop) will be initiated and prepared for delivery on September 15.

TD 1570 Electrical Interface Control Documents - Revision B to ATM/NRL S-082 ICD 40M35586 has been released to the ATM Project Office. ATM/GSFC S-056 ICD 40M35586 has been baselined by CCB action. The ICD 40M35590-1 and 40M35590-2 ATM/ESE Carry On Electrical Interface, released to ATM Project Office May 1969, was baselined by CCB action on July 15.

A preliminary ICD ATM/ESE Umbilical Electrical Interface 40M35630 was released on July 31. Two ATM IRN's were initiated and forwarded to ATM Project Office.

TD 1571 AAP and Saturn Electrical Panel and Working Group Support -
An Electrical Panel meeting is presently scheduled for August 14 and 15. No Panel Secretary duties will be performed by Sperry personnel for this meeting. The Sperry representative will attend the meeting as an observer only for training purposes. The orbital vehicle, the dry workshop, the ATM/AM/CSM interfaces, and the past electrical panel and working group meetings and minutes were studied in preparation for the panel meeting. Branch agenda items were developed for discussion.

II. STAFFING

The Appendix was supported by 25 permanent and one temporary employee during the period. Recruiting efforts to fill the two authorized engineering openings are continuing.

July, 1969

ON-SITE MANPOWER

SUMMARY

The various on-site appendices were being supported on July 31, 1969, by the number of employees indicated below.

Appendix	Schedule Order	Authorized	Permanent	Temporary
A-1	201	13	13	0
B-1	202	19	19	0
C-1	203	57	55	1 Summer
D-1	204	27	27	3
D-1	212	14	14	0
E-1	205	67	66	2 Summer
G-1	207	19	19	0
H-1	208	6	6	1 Summer
I-1	209	72	72	1 Summer
K-1	227	27	25	1 Summer
Total (All Appendices)		321	316	9

July, 1969

APPENDIX B-2
(Schedule Order 216)
ELECTROMECHANICAL DESIGN AND DOCUMENTATION

I. TECHNICAL PROGRESS AND ACCOMPLISHMENTS

TD 200: Star Tracker Illustrations - This task was completed and delivered to S&E-ASTR-M on July 31.

TD 202: ATM Solar Panel Documentation - This task has been cancelled and replaced by TD 210 in accordance with S&E-ASTR-M request.

TD 208: Vibrator Team Table Adjustable Base - This task was completed and delivered on July 31.

TD 209: Optical Tracker Report - This task was completed and delivered on July 31.

TD 210: ATM Solar Array Panels - A TD review was generated and submitted on July 15 recommending a final completion of this task on September 30. The magnitude of this task has grown to include full documentation for the remaining three wings as well as the conversion of shop documentation to Class I documentation for the antenna release mechanism and associated details. This task is progressing on schedule as established in the TD review.

TD 211: ATM Spar Support System -

- A. Design layouts for the air-bearing assembly, spar support structure and mirror box assembly have been delivered, reviewed and signed off.
- B. Detail drafting has commenced on the air bearing and mirror box assemblies.
- C. Design mods are being incorporated in the spar support structure design layout in order to accommodate a new gimbal stop ring and its interface with the Quality Branch spider support.
- D. Design concepts for the test fixture are being developed to include the use of a prototype spar assembly, prototype roll and p/y gimbal rings, flexures and roller mechanisms.

TD 212: ATM Solar Array Ground Equipment (IR Cage) - A task criteria meeting was held on July 31 to establish the requirements of this directive. As a result, the first phase was established as the design of a tri-planar mounting mechanism to hold the IR cage lamps. Ease of adjustment,

stability, and a specified angular movement were set as design specifications.

TD 400-2: CRB Module - A TD review was submitted on July 15 revising delivery schedules because of circuit changes instituted during the month. It was forecast that the requested changes could be implemented by September 2, and that the entire documentation effort would be completed by November 3. Current status and progress is as follows:

- A. Battery Assembly - Minor changes were made on battery mounting detail drawings. The remaining work includes a wiring harness drawing which will be developed after prototype build.
- B. CBRM Electronics - The redesign of three PC boards is in process and approximately 30 percent of the documentation changes have been implemented. Currently, all circuit board schematics are being updated to the prototype unit as a base line for checking PC boards.

TD 401-1: X-ray Event Analyzer - Circuit changes received in June continue to be made on the applicable drawings. Sperry's estimate is for completion of this task by September 15.

TD 403: Power Supplies and Motherboard for Camera Electronics - All circuit boards and mechanical components were completed and delivered on July 18. Wire run lists are being made and a rough draft was submitted on July 31. Completion of the remaining work by August 8 is estimated.

TD 406-2: ATM TV System Sync Generator - The design and documentation of four PC boards and a motherboard is progressing on schedule and will meet the August 25 delivery schedule.

TD 407-1: AC-DC Converter - This task was completed and delivered on July 30.

TD 408: Battery Conditioner Generator - This task has been replaced in its entirety by TD 439-1.

TD 414: Camera Electronics - Final delivery of nineteen PC boards with sufficient documentation for prototype build was made on July 9. During the month the design of the housing was begun and is 50 percent complete. S&E-ASTR-M requested that a "hog out" housing be designed rather than using a sand casting similar to XREA. Upon completion of prototype tests, final documentation will begin, thus extending the delivery of this task to September 26, or later.

TD 416-3: ATM TV System - This task continued on schedule during this month. It is forecast that the September 1 delivery will be met.

TD 418: Heat Pipe for GASA Laser - This task is being worked in conjunction with TD 436. It is forecast that it will be concluded on August 1 along with the developmental unit.

TD 419: Motor Drive - Design and documentation have been completed and this task will meet the August 1 delivery date.

TD 420: H-Alpha Camera Electronics - Class I documentation is progressing on schedule. Engineering changes were received and are being implemented.

TD 422: X-ray Telescope Test Chamber and X-ray Source Chamber - Design and documentation of the source and test chamber was completed and delivered on July 31. Preliminary design layouts of the handling dolly and overhead beam were submitted for approval. Upon approval, detail drawings will be generated. It is estimated that completion will be by August 29.

TD 424: Saturn Ground Computer Remote Control System - This task was completed and delivered on July 1.

TD 425-1: Thermal and Electronic Interconnection System - Detailing of a hold fixture for integrated circuits was completed and delivered. Layouts of a case design for the ATM camera have been completed. A design study of the conversion of the hand-held TV camera to color and of the optimization of the form factor is being conducted.

TD 428-1: Documentation of Precision Optical Tracker - This task was completed and delivered on July 28. Revising additional schematics caused a slight delay.

TD 430: Battery Design - An isometric drawing depicting the packaging scheme per existing data was generated and delivered on July 23. Sperry is awaiting information on the cell configuration which is needed for completion of this task.

TD 432: Wide-Band Comparator and Amplifier Modules - Revision of the layout, artwork, and PC boards per engineering changes is underway and will meet the required delivery of August 1.

TD 436: GASA Laser Adjustment - This task is progressing on schedule and its completion will meet the required due date of August 1.

TD 438-1: Equipment Layouts for Building 4476 - Design of the screen room and storage tank piping has been completed. Sperry is awaiting engineering information on the valves and miscellaneous hardware locations. If this information is received during the first week in August, completion of the task can be accomplished by September 10.

TD 439: ATM Battery Checkout Console - This task is progressing on schedule. During the month, nineteen drawings were completed and delivered. Completion by September 15 is forecast.

TD 441: SD 53 Modifications - This task remained in backlog during the month so that higher priority tasks, such as TD 416, could be completed. Work on this task will resume in August and will be completed prior to September 1.

TD 445: Remote Sensing PC Board - This task was completed and documentation delivered on July 28.

TD 446: Integrated Circuit Masks - This task remained inactive during the month awaiting new laboratory techniques under development by MSFC.

TD 449: Semiconductor Charts - Seven charts were completed and delivered on July 31. Sperry is currently awaiting information so that the balance of the required charts can be completed.

TD 450: Optical Telescope Experiment (OART) - Design layouts were generated and submitted for approval on July 22. Upon approval, detailing will begin. The September 1 delivery will be met.

TD 451: S056 Camera Electronics Card Tester PC Board - This task remained in backlog during the month so that higher priority tasks could be completed. A forthcoming TD review will revise task completion to August 26.

TD 452-1: Acquisition Simulator System - A program interface chart, mechanical component detail drawings, PC masters, drill and trim drawings, schematics and assembly drawings, and the telemetry acquisition system large diagrams were completed. Source control drawings for a command receiver and recorder are being generated.

TD 453: Orbital Workshop Solar Cell Soldering Fixture - Design concepts and layouts were generated during the month and have been reviewed by S&E-ASTR-M. Design of a single fixture to provide for soldering both sides of the chip at one time is being pursued.

TD 454: Audio Amplifier for Bouyance Tank Command System - This task is currently in work but had remained in backlog for most of the month of July. It is forecast that this task will be completed by September 1.

TD 455: Simulated CBRM Shear Panel - This task was completed and documentation delivered on July 29.

TD 456: Camera Checkout Equipment (ATM TV System) - This task is presently in backlog due to higher priority tasks. A TD review is forthcoming to establish an extended delivery schedule.

TD 457: Dual Channel Carrier Test Board for DC Amplifier - This task is currently in work and progressing on schedule. The delivery schedule of August 18 will be met.

TD 458: Command Decoder Mounting - This task is currently in work and progressing on schedule. The delivery schedule of August 15 will be met.

TD 603: Evaluation of Flight Data and Criteria - Acoustic response test data from 35 graphs were reduced to composite liftoff and flight graphs.

TD 604: Evaluation of Test Techniques and Results - Two qualification test reports pertaining to umbilical connectors were coordinated with line engineers for review and concurrence.

TD 802: ATM Solar Array Dynamic Analysis - The initial phase of the transient response analysis of the deployed solar wing to docking has been completed and a preliminary report was submitted. The response consisted of displacement, velocity, and acceleration. Internal member loads are to be analyzed in future work.

A report titled Dynamic Analysis of ATM Solar Array - (Analytical Investigations in Support of Computer Math Models) was prepared and issued.

A report containing the results of a harmonic analysis and internal member loads for the panels and mounting structure in the cinched configuration, is being finalized.

TD 806: ATM Solar Array Test Support - A series of test reports summarizing the results of vibration testing of the ATM solar array structural model were received. Evaluation of test data is in progress.

TD 808: CBRM Thermal - Thermal analyses of both aluminum and magnesium CBRM housing models have been completed. A report has been prepared and will be issued during the week ending August 8.

TD 809: XRT Stress and Dynamics - The micro-dynamic analysis of the S-056 and S-055 cameras was reviewed and revised. The results of the analysis were summarized in a presentation held July 15.

The dynamic analysis of the X-Ray Telescope was completed. A report containing frequencies mode shapes, magnification factors and internal forces will be issued during August.

TD 810: X-RT Thermal Test Support - A review of the prototype model X-ray telescope thermal vacuum test setup and environmental conditions was conducted. The following recommendations were made:

- A. Modify thermal shroud to include effect of ATM camera magazine access door.
- B. Insulate simulated X-spar on bottom surface to provide better thermal contact.
- C. Insulate X-REA housing surface adjacent to the X-RT assembly.
- D. Place a thermal shield directly aft of the camera magazine guide as proposed for the ATM.

Discussions were held, after preliminary thermal vacuum testing, concerning duty cycle of active thermal control elements on the forward tube. Recommendations were made to increase the duty cycle by increasing the radiator area at the forward tube location by 27 percent. This directive is complete.

TD 811: Thermal Vacuum Chamber - A structural evaluation of the vacuum chambers was initiated. A discontinuity analysis between the head and cylinder wall was completed and design modifications were proposed.

TD 812: IR Cage Thermal and Mechanical - Structural models of the current design and a revised design (43 inches shorter) have been developed using the NASTRAM program. The revised design will be updated to include lamps, support arms and wiring and a thermal blockage calculation will be made.

TD 814: CBRM Thermal Vacuum Test Requirements - The preliminary test plan has been reviewed and a final CBRM thermal vacuum test plan has been issued. A thermally controlled mounting plate required for simulation of the ATM shear panel was conceptually designed. Final design drafting of the mounting plate was monitored.

The scope of this TD has been expanded to include a structural test plan for the CBRM assembly which will be completed during August. Instrumentation requirements for a preliminary test of the CBRM housing are also being developed.

TD 815: Test Specifications and Procedures for ATM Solar Array Components - A test plan for CINCH assembly and for the thruster have been completed. Instrumentation requirements are being reviewed with the Test Laboratory. Instrumentation checkout tests have begun for the thruster test which is planned for mid-August.

TD 816: Heat Pipe Analysis, AAP Skirt - A literature search was made on the theory and applications of heat pipes. The research and development program is presently being outlined.

TD 817: ATM Power Distributors Thermal Analysis - A report titled Preliminary Thermal Evaluation of the ATM Main Power Distributor Design was issued. Work is continuing to determine steady-state temperatures. The thermal model of the transfer assembly was completed and keypunch cards are being prepared.

TD 818: ATM Power Distributor Structural Analysis - Evaluation of the ATM Transfer Assembly was completed. Recommended design modifications were issued. Structural and dynamic analysis of the Power Transfer Distributor was begun.

TD 819: ATM Solar Array Plume Impingement Thermal Analysis - The ATM solar array power and antenna cables were analyzed for thermal response to plume impingement heating. Results of the analysis show that the maximum additional temperature rise due to plume impingement is 36.8° F above the panel temp. A report was submitted on July 30.

TD 820: Structural Analysis Design Support - The scissor arm clips were analyzed for vehicle dynamic loads in the frequency range of 5 to 30 Hertz. No resonant condition exists in this range and the stresses in the clip were found to be negligible. Modifications to the ATM Solar Array's fourth and fifth panels were reviewed.

II. STAFFING

This appendix was supported by 62 people.

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APPENDIX C-2
(Schedule Order 217)
COMPUTER DIVISION

I. TECHNICAL PROGRESS AND ACCOMPLISHMENTS

TD CA-1: Advanced Computer Studies - The following articles were reviewed for space applications;

- A. Associative Processors, John C. Murtha
- B. Associative Memories in Space Applications, Dale C. Gunderson
- C. Introduction to the Associative Process and to Associative System Implementation, A. M. Dean.

A review of associative memory techniques and space system computer organizations will be effected during the next reporting period.

TD CGO-5: MLF Computer (MLC) Operating System Flow Charts - All work formerly reported under TD CGO-1 will now be covered by this new TD.

All micro flow charts are complete in final form. Briefings will be given on a MSFC scheduled basis. The system interface chart has been drafted in final form and delivered to S&E-ASTR-CG.

TD CGO-6: ATMDC Programming Support - Work performed under this TD was formerly assigned to TD CGO-2. The work effort during the month of July was highlighted by continued programming and planning. Delivery of the Interface Program Requirement Document (IPRD) by Systems Engineering has continued to slip. Delivery is expected within the next week. Additional ATMDC orientation and training was given to assist new personnel getting on-board. Study of linkage procedures has shown that potential linkage problems may exist.

Sperry's programming efforts during the reporting period have included the following:

<u>Program</u>	<u>Milestone Date</u>	<u>Percent of Total Work Effort Complete</u>
Momentum Management	Oct. 1, 1969	5%
Distribution and Rotation Law	Sept. 5, 1969	17.5%
FSS and HCO Control	Sept. 25, 1969	20%
Square Root	Aug. 20, 1969	25%
DIVCK	Aug. 20, 1969	25%

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<u>Program</u>	<u>Milestone Date</u>	<u>Percent of Total Work Effort Complete</u>
Common Core	Nov. 15, 1969	25%
BCD Updating	Oct. 13, 1969	0%
Caution and Warning Logic	Sept. 18, 1969	0%
Orbit Plane Error Calculation	Sept. 28, 1969	0%
Slow Loop Control	Sept. 28, 1969	0%
Intermediate Loop Control	Sept. 28, 1969	0%
Combined Assemblies	Nov. 15, 1969	0%
Documentation	Nov. 15, 1969	0%

Total Work Effort is defined as all work required to complete a program. This includes coding, punching, debug and verification of program. The above milestone dates were predicated on delivery of the IPDD on May 15, 1969. Upon receipt of the IPDD some schedule adjustment may be required.

TD CGO-7: SLCC Software Configuration Management Support - Work performed under this TD was formerly assigned to TD CGO-3.

All SLCC delivery letter documentation received was inventoried and distributed. The processing of SLCC program change documentation was continued. Production and distribution of the document index and sort listings was performed on a reduced basis as directed by S&E-ASTR-CG. The converted DIX "WORLD PRINT" program test runs have been completed. Results of the test run are being analyzed to determine the task involved, and establish a tentative schedule for total conversion of all DIX programs to the 1108 configuration. Generation of a mnemonics control program to provide configuration support for ATMDC programming has been completed. Also a tentative ATMDC program configuration control plan was developed and will be presented to S&E-ASTR-CG for consideration and approval.

TD CGO-8: Operating System and Test Program Support - Work performed under this TD was formerly assigned to TD CGO-4.

The SA507-3 operating system validation effort was evaluated at the Saturn V SDF. Particular emphasis was placed on evaluation of the Log Table Wrap Prevent change (ECP 2205). No major problems were found to exist in the software change; however, parts of the change (cycling discrete check modifications) were not included. A PTR was written to cover this deficiency and a detailed report of the tests performed by Sperry was prepared and submitted to S&E-ASTR.

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Continued evaluation of outstanding SA507 PTR's was performed; meetings previously scheduled with S&E-ASTR are still pending.

Four GT16/GE01 program change requests were evaluated, re-written to correct technical applicability, and submitted to the Technical Review Board with recommendations for approval.

TD CGO-10: ATMDC Prelaunch Checkout Programming Support - Preliminary planning was initiated during the last month. Initial preflight requirements were received from Systems Engineering July 25. After reviewing the preflight requirements, flow charts will be generated based upon these requirements.

TD CGO-11: ACE Software Programming Support - Initial efforts on this newly assigned TD have been concerned with familiarization of the present ACE hardware and software systems. A three-week training course on ACE/ATM checkout program development was attended. Detailed procedures and requirements for the generation of ACE system computer program requirements documents will be compiled and presented to S&E-ASTR-CG as required.

TD CGS-16: Digital Computer Program Document Report - The first in a series of formal digital computer program document reports is 90 percent complete in final form for review by S&E-ASTR-CGS. Two additional reports are being processed for preliminary review. Delivery of these is expected in August. These documents will contain introduction, index, purpose, program description, software operating procedure, program listing, flow charts and sample outputs.

TD CGG-11: Saturn V Display System Software Stress Test - Preliminary test plans and schedules have been generated and approved. Detailed test procedures are now being generated which will give the methods of creating software stress and expected results and indications. Each test will be performed and actual results and indications will be recorded. Comments and recommendations will be included.

TD 4006 (CGG-6): Saturn V Display Software - Work performed under this TD was formerly assigned to TD CGG-5.

- A. This period was spent analyzing computer dumps from all sites using Phase V software.
- B. Phase V revision changes have been investigated.
- C. Support for L. E. A. F. operations was provided during the launch of Apollo 11.

TD CGG-8: Saturn V Display System Hardware Support - Work performed under this TD was formerly assigned to TD CGG-4. The DDP224 computer problem, experienced during pre-launch checkout of Apollo 11, was isolated to bit 19 of the memory addressing logic. Two logic boards (FL36 and MS 35) were removed and installed in the laboratory computer where failure was duplicated by heating and cooling board components. Failure was isolated to memory selection logic board type MS35. The failed unit will be returned to the vendor for repair.

The two program halts reported by Saturn V breadboard brings the total number of similar halts, during a three-month period, to six. Only four memory dumps have been obtained. Three dumps have been studied to date with no evidence of programming errors. The problem is believed to be due to breadboard hardware since no similar halts have been reported by other Huntsville or KSC sites. A review of the TV distribution modification for KSC, has been completed and is considered adequate.

A review of Honeywell's recommended approach, to accomplish the requested DDP224 computer modification, for saving the last three program transfer addresses was completed. It is recommended that addresses of all transfers be saved in addition to that of the unconditional jump instruction. This includes transfers due to interrupts and all the conditional jump instructions.

TD CGG-10: Computer System Circuit Analysis and Development - Work currently performed under this TD was formerly assigned to TD CGG-3.

Three reports relating to Saturn V GSE failure analysis were received from S&E-ASTR-CGG. These are being evaluated. Tests were conducted on the 501 and 522 computers involving the 26-volt power supply instability problem.

TD CF-3: Capacitance Measuring Circuit - The test data and technical report were delivered to S&E-ASTR-NFE on July 7, completing this TD.

TD CF-4: 75-Watt Switching Amplifier - The new design approach to the 75-watt switching amplifier has been breadboarded and is being evaluated at ambient temperatures from -55°C to $+125^{\circ}\text{C}$. A few minor problems have been encountered at the extreme ambient temperatures and the problem areas are being investigated. Delivery of the breadboard is to be made on August 4.

TD CF-2: Electronic Engineering Design - This TD was received in late July and work on some of the areas such as the TRW amplifier tests and the integrator circuit boards has been initiated.

II. STAFFING

The staffing level for this appendix is currently at 17. Recruitment of personnel is keeping pace with the increased work scope.

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APPENDIX E-2
(Schedule Order 220)

ELECTRICAL SYSTEMS DESIGN AND DOCUMENTATION

I. TECHNICAL PROGRESS AND ACCOMPLISHMENTS

TD 1: Packaging Design, Charger Battery Regulator Module (CBRM) - The overall CBRM wiring diagram has been checked and verified. The filter cavity has been re-designed. Close coordination between on-site engineering and the off-site documentation was maintained during July.

TD 2: Technical Assistance, S&E-ASTR-EBC Testing Equipment - No activity was required for this TD during July.

TD 3: Fuel Cell Development and Testing - Due to delays in modification of the fuel cell by the vendor, no test was performed and no effort was required on this task during July.

TD 5: EICD and EDS Documentation - This TD was closed on June 29.

TD 6: Evaluation Test Reports - Publication support was provided on Revision C to MSFC Specification 332 during July.

TD 7: EB Drafting Support - No effort was expended on this task during July.

TD 8: EDS Solid State Distributor Development - Effort has been concentrated on the preparation of a summarization report of the development and preparation of documentation suitable for construction of a prototype solid state distributor. This report will be a summary of previous reports and will include the reliability study of the solid state circuitry.

TD 9: S-IU-500ST-2 Breadboard Documentation - This TD covers the maintenance of the Saturn V IU breadboard documentation to the flight configuration of each Saturn vehicle. Revision C of document 40M33080 (Instrument Unit CID) and Revision D of document 40M33081 (Instrument Unit Electrical Schematics) were delivered July 18.

TD 11: ATM Solar Cell Module Specification, Qualification Test Procedure, and Qualification Test Report - The only task remaining is the preparation of the qualification test report. A preliminary rough draft was prepared and reviewed by Sperry engineering during July. This draft contained mostly electrical test data. Work is in progress to include inspection and other test data.

TD 12: Design and Documentation of the CBRM Life Test System - No effort was expended on this task during July.

TD 13: ATM CBRM Specification, Qualification and Acceptance Test Procedures - The CBRM electronic assembly (in-process) acceptance test procedure (40M26705) was delivered to MSFC on July 28. This document includes all illustrations, test schematics, and acceptance test sheets. The CBRM specification (40M26300) remains in hold status pending receipt of thermal vacuum and battery temperature requirements from MSFC. CBRM end-item acceptance test procedure (40M26710) remains in hold status pending results of MSFC review.

Additional work on CBRM qualification test procedure (40M26709) started July 3 with the definition of test equipment to be used. This task is 50 percent complete.

TD 14: Differential Pressure Chamber System - Final delivery was made in June. The TD was closed on July 27.

TD 16: ATM Rack Electrical System - Publication support was provided for the following wire lists:

- 40M33671 - Wire List, Cable Unit 703
- 40M33686 - Wire List, Solar Wing Half Panel
- 40M33687 - Wire List, Solar Wing Full Panel
- 40M33689 - Wire List, Solar Modules Half Panel
- 40M33690 - Wire List, Solar Modules Full Panel
- 40M33674 - Wire List, Cable Unit 710
- 40M33675 - Wire List, Cable Unit 711
- 40M33676 - Wire List, Cable Unit 712
- 40M33677 - Wire List, Cable Unit 713
- 40M33668 - Wire List, Control Distributor

TD 17: Preparation of ATM/ESC Inverter Specification, Qualification Test Procedure and Acceptance Test Procedure - The camera-ready masters of the three documents previously delivered to MSFC on June 6, were returned to Sperry on June 26 for minor changes requested by MSFC. The corrected camera-ready masters were delivered to MSFC on July 8.

TD 18: ECS Inverter - Harness routing difficulties were discussed during prototype fabrication by S&E-ASTR-EPC. An alternate method was discussed and, if proven acceptable, will be incorporated into the documentation.

TD 19: Preparation of Test Procedure for Life Testing ATM/CBRM - This task is being held up by MSFC. No schedule has been established for resumption of work on this TD. No effort was expended during July.

TD 21: Terminal Device Testing - MSFC has orally directed that the qualification test procedure, fabrication procedure, and test report for an

integrated termination system be incorporated into one document to be completed on November 3. Sperry is working toward that schedule although no amendment has been received. Sperry is awaiting completion of the tests performed by MSFC.

TD 22: Analysis of ECS Power Inverter - No effort was expended during July and the TD was closed July 13.

TD 23: Electrical Interface Documents - No effort was expended on this TD during July. It was closed on June 29.

TD 26: ATM Distributor Documentation - The watt-hour assembly was delivered July 1; however, new information received required the generation of three printed wiring boards. These boards are 65 percent complete. A total of 50 electrical schematics and various other drawings were completed for the transfer assembly. Other drawings, including three printed wiring boards, were also completed during July.

TD 27: Harness Design and Fabrication Procedure - The third draft of the electrical harness design specification is now being typed; delivery is expected in early August. Work on this task was deferred by MSFC due to a higher priority on TD 83.

TD 28: Modification of Test Equipment - Amendment 2 was received adding 20 hours to cover addition of a liquid-level control to the system. Delivery will be made during August.

TD 33: Redesign and Modification of the Relay Test Console - This TD requires the evaluation, redesign, and modification of the relay test console to make it suitable for functional manual operation. This task was satisfactorily completed and closed on July 20.

TD 34: Qualification Test Procedure and Acceptance Test Procedure for OWS Solar Array Modules and Hardware - The preliminary draft of the acceptance test procedure (Task 2) for the OWS solar cell modules (40M26443) was delivered to MSFC on July 1. Only Tasks 2 and 3 remain to be completed. This TD is to be amended to change "procedures" to "plans" and to change the schedules.

TD 35: Polyalkene Wire Specification - Although the coordination meeting scheduled for June 30 was postponed by MSFC, work continued on the second draft of a polyalkene insulated wire specification (40M39618) until MSFC directed a cessation of work due to quality problems and outgassing uncertainties.

TD 36: Junction Device Specification - Changes and improvements to the junction device specification (40M39589) and drafting of appendices continued

during the month. Completeness of the upcoming second draft is lacking due to reluctance of the device manufacturer in supplying what he considers proprietary information.

TD 37: ATM Schematics for S&E-ASTR-EBF - A total of 300 AAP-4 schematics were completed during July.

TD 38: Preparation of Charts and Schedule for ATM Program Task - No work was performed on this task during July.

TD 39: Revision to Specification 40M39569 - Continual meetings between MSFC and Sperry on revisions to the connector specification were held during June and July; these meetings were regarded as equivalent to the second draft (due July 1) and the second coordination meeting (due July 15). The document is now being typed and illustrated. Connector manufacturer comments on a few details are still expected. Delivery is scheduled for August 15.

TD 42: Test Plan for Space Nuclear Auxiliary Power System Continuation Testing - No work was performed on this task during July. A new input and schedule is expected on this task by August 14.

TD 43: Procedure for Cleaning Solar Cell Modules - This task was completed and the TD was closed on July 20.

TD 44: Solar Cell Test Report on Lunar Solar Cell Module Designs - This task calls for the preparation of a test report covering the results of testing three lunar solar cell module concepts by MSFC. All tests, with the exception of shock tests, have been completed. A draft of the test report covering the completed tests was prepared and delivered to MSFC on July 7. Further input on July 11 indicates that shock testing will be conducted in the future and the report will be completed then. An amendment will change the delivery date to August 29.

TD 45: Thermoelectric Generator Test Plan - This task calls for the preparation of a test plan for performance testing of a compact thermoelectric generator. As previously reported, this task has been held up. A new delivery date of December 1 will be established by amendment.

TD 46: Procedure for Test Selection of CBRM Components for Printed Wiring Assemblies - This task calls for the preparation of test procedures for component selection during fabrication of 12 printed wiring assemblies, and test selection during CBRM assembly. The typed document, minus the final assembly procedures, was delivered to MSFC on July 3 for review. The procedures for the 12 printed wiring assemblies included 18 test select setup schematics. The final assembly procedures will be developed after the 12 printed wiring assembly procedures are reviewed.

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TD 47: Test Requirement Specification for CBRM Printed Wiring Assemblies - This task calls for the preparation of a specification providing functional acceptance testing for printed wiring assemblies. The review of this document (delivered June 13) was completed July 24. The schedule for incorporation of review comments and technical changes is being established.

TD 48: AAP Logistic Support - The following were delivered during July 1969:

- A. Updated preliminary document (block diagram) defining ESE/Flight ICD requirements for AAP-4.
- B. Two reviewed and processed drawing packages for release through the MSFC documentation system.

TD 49: Reconfiguration of the 20-40-60 Program Distributor Tape Cable - This task was delivered on schedule, July 31.

TD 50: Qualification Testing of ATM Distributors - Engineering support was provided in the performance of the following control distributor tests: humidity, high altitude, acoustical noise, and thermal-vacuum (still in progress); and the following measuring distributor tests: humidity, high altitude, and thermal-vacuum. Support is now provided in preparation of the measuring distributor for acceleration testing.

TD 51: Generation of ATM Acceptance Test Procedure, Specifications Qualification Test Procedure, and Qualification Test Reports - The design specification and the qualification test procedure for the power transfer assembly (documents 40M39594 and 40M39601) were delivered on July 18. Delivery of other documents has been previously reported. Minor changes to delivered documents are being made on an as-required basis. Acceptance test requirement documents, in a preliminary draft form, have been delivered covering the watt-hour assembly and the distributor. These documents are on a hold status pending review and comment. Qualification test reports are on a hold status pending completion of the test programs.

TD 52: Wiring List - Work on Auxiliary Power Distributor, Quality Unit ATM (40M37991) is in process. Estimated completion date is August 1.

TD 53: Preparation of ATM Solar Cell Module Log Book - This TD calls for the preparation of a MSFC logbook to include all information peculiar to the solar cell modules required by personnel who test and handle them, and to provide life history to accompany the solar cell module. The reproducible masters were returned on June 26 for minor changes. The final corrected camera-ready masters were delivered to MSFC on July 8.

TD 54: Develop, Design, and Document a Mercury-Reed-Relay Scanner - Documentation is 70 percent complete. The mechanical portion and the relay boards are complete. The control board is 40 percent complete and the remaining control board has not been started. The scheduled delivery date (July 28) was not met due to insufficient manpower and higher priority work.

TD 55: Structural and Thermal Analysis ATM Distributors - No effort was expended on this task during the reporting period. The TD was closed on July 20.

TD 59: Maintain and Update ATM Network Part List - A computer printout of the ATM part list was prepared and delivered to MSFC on July 15. This printout was updated to include all additional parts requested to date.

TD 60: ICD Requirements for ATM ESE Umbilical - The updated preliminary version of Definition of ATM/ESE Umbilical Electrical Interface, 40M35630 (formally Payload Shroud/ESE Electrical Interface), was submitted to MSFC on July 17. Updating of this document will continue following its technical review.

TD 61: Greenlining of Pin Function Versus ICD's and System Schematics - This TD calls for an updating effort of system schematics for the various distributors used in the ATM system. During this report period, greenlining of the auxiliary power distributor system was completed and compared with the master drawing and wiring list at MSFC.

TD 62: Procurement Log for MSFC Connectors - The formats for use in logging purchases of connectors meeting MSFC specifications are complete and in use. Data are collected continually and the system is in operation. Eighty percent of all connector data have been entered on the log forms. An inspection by MSFC is imminent.

TD 63: Plating Study - The crimping characteristics of Hudson Wire Company nickel-tin plated copper conductor wire were studied and laboratory tested. Early evaluation of the test results indicates the crimping tensile strength of the nickel-tin plated wire is about the same as for nickel plated wire.

TD 65: Radiation Effects/Nuclear Test Support - Sperry personnel are analyzing systems for Space Nuclear Auxiliary Power (SNAP) details and are preparing power output profiles, design parameter comparisons, and system schematics of selected SNAP.

Considerations relating to radioisotopic thermoelectric generators (RTG), and the associated power conversion systems are being evaluated. Comparisons of thermodynamic cycles, thermoelectric element materials, mercury, sodium potassium, and biphenyl heat-transfer fluids; and cascaded thermoelectric systems (versus single converter thermoelectric systems) are receiving attention. A summary is being prepared.

Documents and microfilm pertaining to radioisotopic power production for advanced missions continues to be added to the radiation effects library.

TD 66: Fuse Test Modules Design - No effort was expended on this TD; it closed July 13.

TD 67: Preparation of Qualification Test Procedure and an Acceptance Test Procedure for an OWS Array Junction Box - Due to late receipt of direction and technical input, work was not started on this task until June 19, ten days beyond the due date for final technical input. This task has been delayed due to the unavailability of design drawings and insufficient number of diodes to complete the test specimen for an engineering evaluation test. The diodes were received by MSFC on July 24. After the preliminary draft of the qualification test procedure was written, MSFC requested that the test procedures be changed to test plans. A preliminary draft of the qualification test plan is expected to be delivered to MSFC on August 1. The acceptance test plan is now in process. The final drafts of both documents are expected to be delivered to MSFC on August 29.

TD 68: H-Alpha Film Camera Experiment - Formal documentation of the H-alpha film camera checkout panel continued through July. Ninety percent of the drawings are complete and have been checked. The engineering breadboard model is complete, checked, and was delivered to MSFC on July 23.

TD 69: S-056 ECE - Modification to the timing control panels and tests on the voltage regulators were completed during July. New power supplies were received for the ECE; final assembly and checkout of the racks are expected to resume during August.

TD 70: ATM Power Bus - Final review of the ATM system schematics was completed in July. An analysis of the bus system, redundancy tests, power-up sequence, and the use of 7D119 indication bus was presented to MSFC. A final document version was delivered that included recommendations for changes in the airborne design and addition of commands and indications to the ATM ESE umbilical interface.

TD 71: LM Control and Display Panel - Cable lengths of from 65 to 95 feet have been defined as problems for some experimenters to operate from the ATM control and display panel. American Science and Engineering Company is testing to define line driver requirements and functions. A final report is being prepared to detail all associated problems. Further work has been halted by MSFC.

TD 72: ICD Influence on ESE and Cables - Review of the ATM ESE umbilical interface control documents, with respect to ESE requirements to perform power-up and redundancy tests, was completed and recommended changes were made.

TD 73: Thermistor Signal Conditioning - Design of the thermistor signal conditioning bridge circuits was completed in early July. Analysis of the designs by a circuit analyzing computer (ECAP) is complete except for four circuits. Insufficient availability of the computer has delayed this task. Calculated performance curves for all circuits (based on computer values) are being prepared and will be included in a final edition of Requirements for Signal Conditioning Equipment, ATM/TSU ESE. All part lists for printed circuit assemblies are complete except for differential measurements. The assembly drawing for printed circuit boards is complete. The schematic drawing, containing calibration data for all bridge circuits, is 95 percent complete.

TD 74: Pointing Control System - Technical review of Test Requirements and Specifications document for the pointing control system was completed and an analysis was presented to MSFC on July 28.

TD 75: Datum Display Requirements - No progress was made on this task during July.

TD 76: Design of ATM/ESE - Technical review of the cable interconnect diagram for ATM ESE at LC-37B is complete. Problems were discussed with MSFC. The ESE log for reference designator assignments was reviewed for possible problems in converting to a new numbering system. A few numbers already appear on hardware and will remain unchanged.

TD 77: ESE Power Supplies and Power Systems - Support has been provided MSFC in locating and identifying their power supply complement that is needed for the AAP. An index has been made and searches are going on to fill in the data needed to locate and identify these 200-odd power supplies.

A rough draft of a test report on simulated ESE power, single-point ground system, and regulator system of the CBRM is being written. Delivery is expected in August.

TD 78: Acceptance Test Plan for OWS Solar Array Wiring Harness - No work was performed on this task during July. This task is expected to be started on September 12 when the final technical input is required.

TD 81: Single Section Fuel Cell Test Console Operating Procedure - This task calls for the preparation of a procedure for operation of the test console including flow diagrams and illustrations. A draft of this procedure was prepared and delivered on July 25. Pending review and comments this procedure will be updated and a final draft prepared for delivery on August 31.

TD 82: Incorporation of Changes to the 800-Hz DC to AC Inverter - This task was completed and delivered on schedule (July 25).

TD 83: Revision to Specification 40M39580 - Revision to the astronaut connector specification (40M39580) was a top priority task. An advance issue was submitted to MSFC on July 1 and the final issue was submitted on July 14.

TD 84: Qualification Testing of AAP Electrical Equipment - No demand for engineering support of AAP electrical equipment qualification tests was made during July.

TD 85: AAP-4 Shroud - Preliminary drawings of the electrical system schematics, cable interconnect diagrams, and pin function diagrams for the AAP-4 payload shroud were delivered to MSFC on July 23. Further work on this task was halted by MSFC.

TD 86: Thermal System Unit - All required documentation on hand was received from MSFC and an outline of desired work formats was agreed upon. Verification of the documentation against a master publication and a check of the cable interconnect diagrams against the equipment list are almost finished. This verification includes MSFC comments on the documents.

TD 87: Infrared Cage Design - Equipment has been collected and laboratory space reserved for tests on a Research Incorporated NUMERAC power controller. Tests are scheduled for July 30. Current proposals are being reviewed for interface equipment between ACE and the infrared cage. A preliminary cable interconnect diagram is being prepared for the infrared cage system design.

TD 88: Status Reports and Charts - No support was required to define data and technical information for periodic status reports and progress reports during July.

TD 89: ESS Control & Display Panel - This TD covers the design and documentation required to fabricate an experiment support system (ESS) to support four biomedical experiments associated with AAP. Staffing for this task was completed on July 15.

Effort expended to date has been primarily familiarization with the ESS design requirement document and applicable specifications, standards, and procedures; familiarization with the four biomedical experiments; incorporation of review item discrepancies originating from the Preliminary Review Requirements Board meeting held June 23 into the ESS design requirements document; preparation of the document to be updated; and preparation of a design and development schedule for the ESS which was delivered to S&E-ASTR-EAC July 22.

Preparation of an end item specification and certification test specification for the ESS has begun. Delivery of the certification test specification is expected by September 1.

II. STAFFING

An average of 59.3 people supported this appendix during July. Staffing for the ESS Project is complete.

July, 1969

APPENDIX G-2
(Schedule Order 222)
INERTIAL SENSORS AND STABILIZERS

I. TECHNICAL PROGRESS AND ACCOMPLISHMENTS

TD 1: AB4 Single Axis Platform - This task was completed on July 30.

TD 8: Rotary Bearing and Speed Reducer - Design and drafting for this task has been completed and is currently being checked. A modification to the TD is forthcoming which will extend the delivery date to September 1, 1969. The final delivery of this task will be made on or before this date.

TD 10: Survey of Computer Analysis and Design - Effort on the survey of computer aided analysis and design is continuing as planned. The library search for associated existing material is almost completed, and copies of the majority of the documents have been acquired. A program comparison and evaluation table is being prepared as these documents are studied.

TD 11: Actuator Test Equipment - This task is in the design and detailing stage. Due to its complexity and necessary changes, a modification to the existing TD will be issued to extend the delivery date to September 1, 1969. Final delivery will be made on or before this date.

TD 12: CMG Test Fixture Filter - The filter was delivered on July 15 and tested by S&E-ASTR-G. The results indicated that the phase shift may be excessive. For this reason the TD is being held open until the amount of acceptable phase shift is determined and possible re-design accomplished. A design report for the present filter is being prepared and will be delivered on August 4.

TD 13: UV Platform Positioning and Readout Panel - Progress on this task is temporarily being impeded due to lack of engineering information. A modification to the TD is expected which will change the delivery date to September 1, 1969.

TD 14: ATM Rate Gyro Package Description Document - Reference material is presently being studied and a document outline is being prepared.

II. STAFFING

This appendix was staffed with approximately 4.75 people for this reporting period.

July, 1969

APPENDIX I-2
(Schedule Order 224)
INSTRUMENTATION AND COMMUNICATIONS

I. TECHNICAL PROGRESS AND ACCOMPLISHMENTS

A. Completed Technical Directives

TD 5: Time Control Unit - The time control unit has been delivered and accepted by the technical contact. The unit met all following design requirements:

- a. Decodes either IRIG-B, IRIG-C, or serial decimal codes and displays this timing information in hours, minutes, and seconds on a Nixie readout.
- b. Provides the capability of presetting a start-stop signal for external use.
- c. Provides BCD timing information to a remote time indicator if desired.

Class II documentation and an instruction manual for the time control unit was delivered to the technical contact.

The TD was amended during this reporting period, to provide additional hours and an August 1, 1969, delivery schedule. This was required to modify the input circuit to the time control unit to accept all code signals without requiring adjustment.

Delivery of the test set and associated documentation completed all requirements of this TD. A closeout order will be issued.

TD 35: ATM TV System Video Switch Specification Revision - A reproducible copy of the video switch specification was delivered to the technical contact during this reporting period. This completed all requirements of the TD. A closeout order will be issued.

TD 39: Rewrite of Vidicon Television Camera System Acceptance Test Specification/Procedure - A reproducible copy of the specification/procedure was delivered to the technical contact during this reporting period. This completed all requirements of the TD. A closeout order has been issued.

TD 40: Test Report for X-RT Telescope Qualification Vibration Test - A reproducible copy of the test report was delivered to the technical contact during this reporting period. This completed all requirements of the TD. A closeout order has been issued.

TD 43: H-Alpha Telescope Film Camera Specification - A reproducible copy of the specification was delivered to the technical contact during this reporting period. This completed all requirements of this TD. A closeout order has been issued.

TD 49: Silkscreen Master for Antenna Panel Assembly - This TD was received and completed during this reporting period. Delivery of the silkscreen master completed all requirements of this TD. A closeout order will be issued.

B. Incomplete Technical Directives

TD 1: SRS Decoder, Receiver Environmental Testing - One SRS decoder was received for testing and currently is undergoing tests at Wyle Laboratories. No decoders or receivers were delivered to the technical contact during this reporting period.

At the request of the technical contact, Sperry assisted in and monitored a malfunction analysis test on an SRS decoder on July 19. The test was conducted by the manufacturer using the Sperry test setup at Wyle Laboratories. The manufacturer was unable to duplicate a malfunction reported by the stage contractor. Representatives of the stage contractor also witnessed the test.

The TD is on schedule and within budget.

TD 3: PCM DDAS 303 - No work was accomplished on this TD during this reporting period. Work has been interrupted for an indefinite period due to higher priority assignments. Work will resume when personnel are available.

TD 4: Model 411 and 502 CIU M&I Manuals - This task is being studied to determine the amount of effort required to complete the TD. Additional information required to complete the manuals has been received from Applied Research.

TD 6: P-N Digital Interface Unit - An analysis was conducted during this reporting period to determine tuning techniques and accuracy of filters within the test set. The analysis was performed to determine if the accuracy of the test set could be improved from approximately 1 percent to 0.1 percent. The results of this analysis yielded little optimism about the feasibility of matching the data filters to this accuracy; however, some improvement is anticipated with special tuning techniques. Parts have been ordered for the new filters.

TD 8: Dual Power Supply - Redesign of the converter is complete. The housing has been machined and is being painted. Printed circuit boards and all parts are being procured. All transformers and chokes have been wound. Work is progressing according to the amended TD schedule.

TD 10: ATM Telemetry System Interface Design and Control - The review of ATM post manufacturing test - requirements and specifications was continued during this reporting period.

Meetings were held with NASA - Quality, NASA - Astrionics, Martin - Denver, IBM, and other interested test participants to establish test philosophy and telemetry system constraints and requirements.

The ATM telemetry system description document is being typed in draft form and is scheduled to be delivered to the technical contact for review during this reporting period.

TD 11: ATM TV System Low-Light-Level Camera Documentation - A qualification test report is the only task remaining on this TD. The QTR will be written upon completion of camera system testing. Rescheduling of the delivery date for the TD will be done when test results are available. The TD is within budget.

TD 13: ATM TV System Vidicon Camera Tube Documentation - A qualification test report is the only task remaining on this TD. The QTR will be written upon completion of the vidicon camera tube testing. Rescheduling the delivery date will be done when test results are available. The TD is within budget.

TD 14: Fourier Analysis of Digital Data - Methods of operating on the spectral pattern of an image by linear and nonlinear filtering techniques were investigated during this reporting period. Different spatial filter patterns were found to have the effect of enhancing various aspects of the image. These enhancement capabilities are being studied further.

TD 15: Data Compression Facility - No work was accomplished on this TD during this reporting period pending redefinition of the work scope.

TD 18: Cluster Systems Antenna Document - Writing and illustration efforts for this TD are progressing according to schedule. Completed illustrations have been delivered to the technical contact for review. Eighty antenna patterns for three antenna systems were received and processed for incorporation into the document. Page formats for the document were completed. The TD is on schedule and within budget.

TD 19: Transient Generator - The mechanical layout of the transient generator is nearing completion. Fabrication of the front panel has been completed. Documentation for the three printed circuit cards is approximately 50 percent complete.

Some difficulty is being experienced in meeting the rise time requirement (0.5 microseconds or less) for the minus 100-volt pulse. Investigation of methods

to alleviate this problem are being pursued. The technical contact has been advised of the difficulty.

TD 20: ASA Test Set - The ASA test set has been completed and delivered. The test set was demonstrated and explained to the technical contact upon delivery.

A trip was made to the Teledyne Company to review the ASA acceptance test procedure.

There is a possibility of design changes in the ASA which would result in changes to the test set.

TD 23: Harmonic Tracking Filters - During this reporting period, six IF filters for the airborne unit were tuned to the IRIG standard 4k Hz channel spacing. The tuning effort is continuing. It is anticipated that the entire filter set will be completed in October. The evaluation of the ground station loop is currently inactive and will remain so until tuning of the airborne unit is complete.

A TD review has been submitted requesting an extension of the TD to include the additional work now being performed.

TD 27: ATM TV System Sync Generator Documentation - A qualification test report, to be written upon completion of testing, is the only task remaining on this TD. Rescheduling the delivery date will be necessary when test results are available. The TD is within budget.

TD 28: Antenna Pattern and Boresight Measurement Study - A meeting was held with the technical contact to discuss a proposal for a scale simulation of the antenna tower to study loading deflections.

The technical contact agreed to the proposal and agreed to amend the TD to cover the expenditure of the model tower. Analytical analysis of the tower is being delayed due to lack of personnel, however, this phase will be completed during the next reporting period.

TD 29: Input Data Simulator - Engineering for the two units was completed during this reporting period. Drafting effort for the units is 75 percent complete. The delivery schedule for the units has slipped to approximately August 15 due to delays in receiving ordered parts.

TD 34: ATM TV System Video Switch Qualification Test Report - Test data have not been received from the technical contact, therefore, no work could be accomplished on this TD during this reporting period. The TD is within schedule and budget.

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TD 36: Rewrite of Low-Light-Level Television Camera System Qualification Test Specification/Procedure - A review copy of the specification/procedure was delivered to the technical contact during this reporting period. The document will be completed and delivered in final form to the technical contact pending completion of review.

TD 37: Rewrite of Low-Light-Level Television Camera System Acceptance Test Specification/Procedure - A review copy of this document was delivered to the technical contact during this reporting period. The document will be delivered in final form to the technical contact when review is completed.

TD 38: Rewrite of Vidicon Television Camera System Qualification Test Specification/Procedure - Changes were incorporated and the document was delivered to the technical contact for review. It will be delivered in final form to the technical contact upon completion of review.

TD 41: Test Reports for Pressure Transducers - Work was initiated on this TD during this reporting period. One of the five flash reports has been delivered to the technical contact for review.

During preparation of the first flash report, excessive manhours were expended making the calculations required to reduce the raw data. It was recommended that Sperry write a computer program to speed processing of data. This program is currently being written.

TD 42: PSK Detector Study - The reliability circuit analysis for the PSK detector has been completed. The redundancy study for the PSK detector is currently underway and is progressing according to schedule. Breadboarding of portions of the PSK detector has been initiated to verify some of the redundancy concepts. The TD is within schedule and budget.

TD 44: ATM DC-DC Converter Qualification Test Report - Test data were received for this report during this reporting period. Work is scheduled to begin approximately August 15. A TD review was written advising the technical contact of the starting date.

TD 45: Rewrite Yoke Alignment Instruction Document - Work was initiated on this task during this reporting period. A final draft copy of the document was delivered to the technical contact for review. The TD is within schedule and budget.

TD 46: Yoke Assembly Instructions and Documentation - Work was initiated on this TD during this reporting period. A review copy of the potting procedure was delivered to the technical contact. The TD is within budget.

TD 47: Environmental Test Program Monitoring for Goddard X-RT, Goddard Film Camera, and Goddard H-Alpha Film Camera - This TD was received and work was initiated during this reporting period. Several problems occurred during environmental testing of the X-RT camera. The tests are being rerun.

TD 48: Qualification Test Procedure for ASAP Memory Module - This TD was received during this reporting period. Work is scheduled to begin on or about August 1.

TD 50: H-Alpha Film Camera Electronics Acceptance and Qualification Test Procedure - This TD was received and work was initiated this reporting period. The qualification test procedure is currently 80 percent complete. The TD is on schedule and within budget.

TD 51: Mobile ATM Breadboard Equipment Rack - This TD was received this reporting period and work was initiated. The equipment rack design has been completed. Fabrication is scheduled to begin the first week in August.

TD 52: TCS Monitor - This TD was received and work was initiated during this reporting period. The package concept has begun on the TCS monitor. The TD is progressing according to schedule.

TD 53: Source Control Drawings for Temperature Gauges - This TD was received during this reporting period. Information on the seven source control drawings has not been received, but is anticipated the first week in August.

TD 54: Revision and Correction of Assembly and Source Control Drawings - This TD was received during this reporting period. Information on the drawings has been received and work was initiated. The TD is progressing according to schedule.

TD 55: Literature Search on Analog and Digital Modulation Techniques - This TD was received late this reporting period and work was initiated. The literature search is currently in progress.

II. STAFFING

During this reporting period, eleven engineers, four technical writers, and three technicians worked on tasks assigned to this appendix. Additional support in drafting, typing, illustration, and assembly was utilized as required.

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APPENDIX J-2

I. TECHNICAL PROGRESS AND ACCOMPLISHMENTS

A. Schedule Order 225, ATM ENGINEERING MANAGEMENT SUPPORT

Program Schedules - Impact to the ATM Program Schedules, due to the decision to go "dry" workshop rather than "wet" is being analyzed. Change information is being assembled for the next update of the Level III ATM Program Schedules Document.

Monthly Progress Review - Program Schedules are being monitored and normal coordination is being performed in preparation for the next review scheduled for August 26 and 27.

Critical Design Reviews - Sperry personnel attended several Critical Design Reviews (CDR's) during this reporting period. Data packages were obtained and placed in the ATM file. Action items and minutes of the reviews were recorded and distributed to attendees. The documentation received is being baselined by the Configuration Control Board.

Testing Support - Five meetings concerning ATM testing were attended, with technical backup information being furnished by Sperry.

Cleanliness Specification - The rewrite from last month was not considered all inclusive; consequently, additional information must be researched and incorporated. In addition, a format change was requested by the ATM Engineering Manager. An outline of the revised format was completed and delivered to the ATM Engineering Manager for approval.

Sequential Flow - Photographs of several pieces of ground support equipment were taken. Formats were prepared for illustrations to be incorporated into a revised sequential flow document.

Transportation Plan - A preliminary design review of the ATM transporter was attended with changes to the document resulting.

Environmental Design and Qualification Test Criteria - Four Engineering Change Requests concerning this document were received with each requiring an Engineering Order. A comparison of this document with the ATM Equipment List was requested by S&E-P-ATM.

ATM Quality and Reliability Plan - Revision A to this document was completed and delivered to MSFC for approval on July 25.

ATM General Test Plan - This document is being revised to reflect the latest engineering changes. It is approximately 80 percent complete. A scheduled completion date will be established as soon as the "dry" workshop configuration is finalized.

Configuration Management Activities -

1. The Monthly ECP/ECR Status Report was updated and released. EO's resulting from CCB meetings are being researched for incorporation into future ECP/ECR monthly reports.
2. The card index file is 55 percent complete.

The following ATM configuration management activities were accomplished:

1. Documents Received and Processed

Preliminary Interface Revision Notices and Interface Revision Notices	3
Engineering change requests	12
Engineering change proposals	10
Configuration Control Board directives	10
Configuration Control Board agenda/minutes	1
Change orders	6
Specification change notices	10
Engineering waivers	17
Deviation Approval requests	2

2. Meetings Attended

Level III Configuration Control Board	1
Drawing release	11

3. ATM Documentation Project Files

Documents received	140
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Drawings received	860
Documentation distributed	96
Engineering Orders received	40

ATM Equipment List (50M72900) - Engineering data are being collected and checked out in preparation for Revision C. No publication date has been established for this document.

ATM Thermal Mechanical Test Unit (50M73428) - Distribution has been completed. Forty pages of thermal dummy component data have been compiled and verified. Revision of this document is directly proportional to the status of 50M72900.

ATM Vibration Test Unit (50M73427) - Distribution has been completed. Forty pages of vibration dummy component data have been compiled and verified. Revision of this document is directly proportional to 50M72900.

ATM IP&C/TSU (50M02479) - Considerable coordination has been necessary for data clarification and possible addition or deletion of thermal measurements.

ATM Checkout and Test Requirements Specification (50M02425) - Considerable coordination has been necessary to assure that Martin/Bendix, Astrionics, and Quality engineers are in agreement on checkout and test requirements.

Experiment Interface Defining Document (EIDD) -

1. Experiment S-052 - One engineering order (Number 28) was completed on EIDD (50M02414), the White Light Coronagraph Experiment.
2. Experiment S-054 - One engineering order (Number 10) was completed on EIDD (50M02429), the X-Ray Spectrographic Telescope.
3. Experiment S-055A - Two engineering orders (Numbers 11 and 12) were completed on EIDD (50M02430), the Ultraviolet Scanning Polychromator-Spectroheliometer Experiment.
4. Experiment S-056 - One engineering order (Number 8) was completed on EIDD (50M02431), the X-Ray Telescope Experiment.
5. Experiment S-082 - One engineering order (Number 34) was completed on EIDD (50M02462), the XUV Spectroheliograph and the XUV Spectrograph Experiment.
6. Experiment H-Alpha - One engineering order (Number 8) was completed on EIDD (50M02463), the H-Alpha 1 and H-Alpha 2 Experiment.

B. Schedule Order 211-1, PROJECTS OFFICE SUPPORT

TD 211-A-5: ATM Schedules, Reports, and Test Documentation - The ATM Experiments Qual Test Status has been submitted to the Engineering Manager.

The Qual Test Specifications/Procedures are being reviewed against the Environmental Design and Qual Test Criteria for Apollo Telescope Mount components.

The S-054 Experiment Qual Test Procedures were submitted to the Quality Laboratory for review and comments. Five ATM Certificates of Qualification (COQ's) are currently being reviewed by S&E-QUAL.

The following ATM configuration management activities were accomplished:

1. Documents Received and Processed

Memoranda	3
Preliminary Interface Revision Notices and Interface Revision Notices	1
Engineering change requests	16
Engineering change proposals	10
Configuration Control Board agenda items	20
Configuration Control Board directives	15
Engineering orders	7
Interface control documents	1

2. Meetings Attended

Level III Configuration Control Board	1
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3. Documents Originated

Memoranda draft	22
Miscellaneous correspondence draft	4

TD 211-A-6: Payload Integration Task Monitoring - The AAP Payload Integration Contract Document Matrix was updated and distributed to all interested MSFC organizations.

TD 211-A-7: ATM Equipment Accountability - Delivery schedules for ATM thermal mechanical unit (TMU) and vibration test unit (VTU) hardware and documentation are being met with a total of 132 TMU's, 15 VTU's, and nine formfit and wiring units delivered to S&E-ASTN and S&E-ME. Assistance continues in providing current TMU pin-function data and connector size and locations on individual components. A memorandum was generated to place a requirement for providing four switch selector VTU's and to ensure fabrication of these units.

TD 211-A-8: ATM Materials Test Program -

Materials submitted to S&E-ASTN for outgassing tests 44

Materials submitted to S&E-ASTN for flammability tests 1

Coordination of all test results was performed to provide quick analysis of ATM materials. In order to maintain current status and scheduling of material tests, two reports were submitted to S&E-ASTN presenting the preferred test sequence.

TD 211-E-7: ATM Experiments Data - Sperry has completed the cross-reference system for all change papers concerning the White Light Coronagraph (S-052) Experiment.

Three charts depicting schedules, document numbers, and titles for qualification testing of the S-052 prototype unit were developed and completed.

TD 211-P-6: Schedules, Information, Analysis and Reports - Sperry completed 675 index file cards containing information on ATM electrical schematics.

Revisions were made to two experiment measuring list forms.

Sperry produced twenty-five vugraphs for Hamed Decibel forms and completed one chart on the Research Technology Operation Plan, (RTOP), and one chart on the Request for Funding forms, 1122, for S&E-ASTR-ET.

TD 211-P-7: Test, Reliability & Quality Assurance - Unsatisfactory Condition Reporting - A total of nine UCR's and ICAR's were processed, reviewed, and completed during this reporting period. Information for the monthly UCR Status Report was provided to the Special Projects Group for forwarding to the Office of the Director, Astrionics Laboratory.

A total of 505 information UCR's and ICAR's were processed during this reporting period.

Two deviation requests were processed for approval during this reporting period.

TD 211-V-2: Vehicle/Stages Configuration Management - The following activities were accomplished:

1. Meetings Attended

Level II Configuration Control Board	3
Level III Configuration Control Board	13

2. Documents Received and Processed

Preliminary Interface Revision Notices and Interface Revision Notices	27
Engineering change requests	18
Engineering change proposals	128
Configuration Control Board directives	164
Configuration Control Board agenda (Active)	52
(Pending)	75
Change orders	31
Interface control documents	4
Production revision records	2
Discrepancy checks	2
Memoranda	49
Miscellaneous correspondence	20

3. Documents Originated

Memoranda drafts	15
Miscellaneous correspondence drafts	6

S-IC Test Specifications and Criteria were updated with released Engineering Orders.

Technical documentation for follow-on stages (S-IC-16 through S-IC-21) was reviewed for dispositioning.

TD 211-W-1: Flight Experiments - The data summary chart is undergoing a second major update. There has been one addition, no deletions, and all experiments have required a data change.

TD 211-W-2: AAP Status and Documentation - Work is continuing on the quality review description chart for Orbital Workshop components. This chart was revised to show only those components applicable to the dry workshop. The multiple docking adapter chart is undergoing a similar change.

TD 211-W-3: OWS/MDA Configuration Status - The following AAP configuration management activities were accomplished:

Documents Received and Processed

Technical Engineering Field documents (EIDD's)	22
Miscellaneous correspondence	3

II. STAFFING

A. Schedule Order 211: The equivalent of 16 people supported this SO during July.

B. Schedule Order 225: The equivalent of 6.5 people supported this SO during July.

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APPENDIX K-2
(Schedule Order 226)
SYSTEMS DIVISION

I. TECHNICAL PROGRESS AND ACCOMPLISHMENTS

TD 2502: Development of Mathematical Models - The development of an AS-507 trajectory simulation has been initiated. Mass data, presettings, etc. have been obtained. This simulation will be developed for both IBM 7094 and UNIVAC 1108 operation since the Computation Laboratory has not yet provided complete UNIVAC 1108 capability.

The capability of computing apogee and perigee of earth parking orbit has been added to the basic Saturn V trajectory simulation.

Test runs were made to verify the condition of the Saturn V navigation hardware error analysis program.

A small program was developed to compute the state vectors at any time on an elliptic or circular orbit given the state vectors at any other time on that orbit. The program uses an algorithm to propagate injection perturbations to midcourse connection requirements with sufficient accuracy for preliminary investigations. This method has been programmed for operation on the UNIVAC 1108.

TD 2503: APS Studies - Typical maximum body rates for a Saturn V vehicle during coast phase were furnished to S&E-ASTR-SG. The information was furnished for three configurations (S-IVB/IU/LM, S-IVB/IU/LM/CSM, S-IVB/IU) in the orbital and translunar coast phases.

Analysis of AS-505 post-flight data has been completed. The data were typical of past Saturn V missions; however, there were no data available for evaluation of APS during the events of CSM separation, CSM docking, LM extraction, and LOX dump. AS-506 post-flight has been received but has not been analyzed.

TD 2504: LVDC Back-up Studies - The AS-506 Accelerometer Failure Study (SP-233-0233) was completed and delivered to S&E-ASTR-SG on July 7.

TD 2505: DOWS Experiment Pointing Control System Studies - A study and simulation effort was initiated to determine the feasibility of implementing the EPCS equations in a digital computer. Results obtained show that:

- o direct conversion of the existing analog system to digital form, with 10 to 25 hz sampling rate, yields unsatisfactory system performance, having little or no damping.

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- o resolution provided by a 10 data bit counter is satisfactory.

Work is continuing to determine if discrete equations can be placed into the digital computer that will allow stable performance for sampling rates of 10 to 25 hz. Preliminary results indicate that a stable system configuration is possible.

TD 2506: DOWS Control Moment Gyro System Studies - A rotation and distribution law to control the DOWS CMG momentum vectors has been developed, and is documented in Sperry Report No. SP-231-0237 Revised Distribution and Rotation Law for Dry Workshop, July 16, 1969.

Preliminary study is underway to define an optimal law to control gimbal rate as a function of torque required with minimal axis cross-coupling.

The optimal desaturation digital simulation is operational and is ready for production. The weighting factors presently used require further evaluation as results do not give expected desaturation.

Development of the navigation and timing routines for the simulation of the DOWS digital computer is near completion and will be ready for checking out these routines by August 4. Weekly meetings to discuss problem areas have been initiated with S&E-ASTR-SG.

TD 2507: Thrustor Attitude Control System Studies - Study of the DOWS has continued. Simulation runs showed that alignment of the geometrical Y-axis perpendicular to the orbital plane (principal axis was used in earlier tests) did not affect fuel consumption. The simulation was also run with no aero torques and showed no significant reduction in fuel consumption. Work was resumed on "driving" the X-axis (in X-POP mode) with the GG torque. This task should be completed in the coming month. The diurnal bulge inclusion in the simulation is near completion. This task was slowed by a problem in timing between the DOWS and diurnal bulge decks.

The wet OWS docking study report is in typing. The DOWS successful docking study is completed and the report is being prepared. A study of DOWS unsuccessful docking was initiated and is about 50 percent completed.

Star occultation due to the $80^\circ \times 180^\circ$ star tracker window was simulated. The results are now being verified. Hand plots of earth occultation have been completed. Simulation of earth occultation is in process.

Non-availability of the 8900 hybrid computer has precluded simulation of the sun acquisition mode of the dry workshop. The hybrid simulation has been updated to include dry workshop mass and torque data and a Z-axis control procedure using two discrete sensor heads.

A method of computing the simulation initial conditions as a function of launch time was developed and presented to S&E-ASTR-SG. The initial conditions found are the location of the line of nodes, the sun vector, and orbital midnight. These initial conditions will be used with the 520 computer and with the 8900.

A familiarization effort has been established to effect a smooth transfer of this function (TACS Impulse Budget) to the APS studies group. The request for computation support has been submitted and an impulse prediction has begun for the latest Dry Orbital Workshop mass data.

Research has been initiated to provide the required information for development of digital computer program for the strapdown navigation error analysis.

TD 2508: Lunar Roving Vehicle (LRV) Study - A study of the feasibility of the proposed drive and steering controls for the lunar roving vehicle has commenced.

TD 2509: Apollo V Guidance Implementation and Navigation - The weekly IBM meetings were attended with emphasis placed on the review of Flight Program Deviation Reports.

The following flight program change requests (by FRB member) were reviewed for technical accuracy in the areas of S&E-ASTR-SG responsibility: 1056, 1058, 1059, 1060, 1061, 1062, 1063, 1065, 1066, 1067, 1068, 1069, 1070, 1071, 1072, and 1073.

Work was begun on a J2S engine characteristics summary document for S&E-ASTR-SG.

Preliminary work has been accomplished which will lead to the development of a trajectory simulation for the two-stage-to-orbit (Dry Orbital Workshop) Saturn V mission. Investigation of the flight program changes required by the mission is under way.

Investigation of IGM modifications proposed for future missions by Boeing (document 5-9640-H-212, IGM Modifications resulting from J-2S Guidance Study and S&E-AERO is progressing after many delays caused by errors by programmers at the Computation Laboratory.

TD 2522: ESE Systems - A compilation of data inputs pertaining to long-term storage of GSE and ESE equipment was prepared for a meeting and discussion. Approved inputs and suggestions are being incorporated into a revised package. This is a continuing review effort and future meetings will be required.

TD 2523: Configuration Control Board (CCB) Activities - Technical information and evaluations were obtained from the responsible engineering organizations in support of Engineering Change Proposals (ECP's) and Engineering Change Requests (ECR's). The stage changes and their related ESE changes were monitored and presented to Systems Engineering for evaluation in support of the Stage Projects Office. The ESE changes were presented to the Level III Configuration Control Board (CCB) on a daily basis. The evaluations for the stage changes were obtained for the Projects Office which in turn presented them to their respective Level III CCB's. All expedited changes in support of particular vehicle effectivities were handled in a timely manner. A daily status of all change activity in the electrical support equipment and their related stage changes was recorded and a master file of changes and related documents was updated.

TD 2524: ESE Interface Control Activity - Special attention was given to the Level A interface Revision Notices (IRN's) that were associated with the launch of AS-506. Daily contact with KSC was necessary to insure that there was complete agreement in changes to the documents that were submitted prior to the launch of AS-506. No critical changes were left outstanding prior to launch. The normal flow of IRN's, both Levels A and B, were processed and submitted to the appropriate Level II Configuration Control Board. A current running status was provided to the affected organizations.

TD 2531: Saturn and AAP Instrumentation Systems Management - Saturn and AAP measurement systems IP&CL's and ICD's were maintained and updated with PIRN's, IRN's, ECP's, ECR's, CCBD's and EO's. Meetings and other communications methods were utilized to advise MSFC personnel and stage contractors of the status of all IP&CL's and ICD's. A detailed report of all work accomplished under this TD has been forwarded to the cognizant MSFC technical contact.

TD 2551: Technical Document Review - The review of the Airlock Module (AM) documents and the developing and drawing of functional block diagrams for the electrical and electronic systems has continued. The study and analysis of drawings obtained from the MSFC Technical Documentation Center is progressing on a low priority basis.

A review is being made by Sperry of the Circuit Performance and Component Stress Analysis Report by AiResearch Manufacturing Company on the Apollo post-landing-ventilation fan (ECS, Item 6-1).

TD 2552: Level II Math Modeling Program - There was no effort expended on this TD during this reporting period.

TD 2553: Technical Information Summary - Sperry personnel assisted in the initial distribution of 1500 copies of the Technical Information Summary for Apollo 11 (506).

A target date for completion (to printing) of the Apollo 12 Summary was tentatively set for October 22, 1969.

TD 2554: Failure Mode, Effects and Criticality Analysis for ATM Telemetry Equipment - A summary of activity during July, and the current status for each FMECA being developed follows:

- A. ASAP Computer Interface Unit - An updated and revised preliminary copy of the FMECA has been completed and is being reviewed by NASA personnel in the Telemetry Design Section.
- B. PCM/RF Transmitter Assembly (RF-10P) - This analysis remains dormant awaiting release of documentation by a new contractor.
- C. ASAP DC to DC Converter - The FMECA report was completed the second week of July and submitted to the Telemetry Design Section for final approval. An additional schematic is now being added, and it is anticipated that the report will be released to MSFC Technical Documentation in August.
- D. Amplifier and Switch Assembly (ASA) - Several conferences have been held with design personnel to discuss documentation requirements, design changes, and functional description of the ASA. All documentation, including latest changes, has now been received. The analysis is scheduled for completion by the end of August.
- E. Memory Module - The drawings and documentation were studied during July. In addition, a great deal of information was accumulated concerning the module operation and functional description. A preliminary report is expected before the end of August.
- F. ASAP Interface Unit - A minor delay was experienced in the development of this analysis because of missing information on the functional description of the AIU. This FMECA is more than 80 percent complete and portions of the preliminary report are in preparation.
- G. Overall Telemetry System - Review and analysis of the I.P. & C. list and the "black box" level FMECA's are continuing. The block diagrams have been completed and a conference held with personnel of the ATM Mission Office at MSFC (I-MO-R). This analysis is progressing along with the "black box" level FMECA's. However, unless some special arrangements are implemented concerning the Analysis of the Transmitter (RF-10P), a rather long delay may be experienced.
- H. ASAP Cables - The FEA writeup which is to be included in the Overall Telemetry System FMECA is approximately 50 percent complete.

TD 2555: AAP Program Guideline for FMECA on Component Level Equipment - The preliminary report on these guidelines is nearing completion. Present schedules indicate that the first draft of the final report will be ready by the end of the first week in August.

II. STAFFING

Thirty-seven people are currently supporting this appendix. Offers have been made to several engineers to fill slots created by the increase in work scope. One additional engineer reported for work during the latter part of the month, but his contribution to the net increase in personnel was offset by the departure of another engineer on a two year military leave of absence.

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APPENDIX L-2
(Schedule Order 210)
ADVANCED STUDIES

I. TECHNICAL PROGRESS AND ACCOMPLISHMENTS

TD L-29: Control Dynamics Studies for Orbiting Space Stations - This task has been completed.

TD L-31: Space Station Power Systems - The definition report on this task is in typing. No effort has been applied to this project this month.

TD L-32: Data Management Model for Near Earth Orbital Space Stations - Efforts are continuing to establish an information management model for large earth-orbital space stations. Some re-direction of effort has occurred due to initial computer returns.

TD L-33: Preliminary Partial Dynamics Studies for Orbiting Space Stations - This task is a redefinition of continuing efforts in the areas covered by expired TD L-29. Emphasis is placed upon studies of Space Shuttle concepts. Initially, a review of aircraft stability and control analysis techniques is underway.

Some investigations of "wobble" characteristics of spinning cable connected satellites have also been performed under this task.

II. STAFFING

Three engineers staffed this appendix during this reporting period.