(U) REPORT ON ATLAS/AGENA LAUNCH OPERATIONS – AMR vs. PMR

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Prepared by:
Space Systems Division Space Launch Survey Team

1 May 1962

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Headquarters
SPACE SYSTEMS DIVISION
Air Force Systems Command
United States Air Force

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REPORT SUBMITTAL

The findings, recommendations and conclusions of this report are hereby respectfully submitted:

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SUMMARY

A Space Launch Survey Team was established for the purpose of reviewing hardware, procedures, and organizational arrangements that relate to Atlas space launchings at the Atlantic Missile Range (AMR) and Pacific Missile Range (PMR). The objective of this survey was to analyze and evaluate any differences for the purpose of identifying those for which one of the alternates appears to be a preferential way of operating, or could contribute to a higher level of success or reliability of space launches.

The Survey Team visited AMR and PMR to review the organizational structure of the 6555th and the 6595th Aerospace Test Wings, their method of management, relationship with SSD, BSD, and the ranges, and control exercised over contractor activities. A comprehensive review of the operating philosophy including the sequence and type of checkout and launch procedures was conducted with contractor personnel and military project officers at each location, followed by a visual review of the type of equipment used for checkout and launch. Using the flight test reports, a detailed review was then made of all Atlas/Agena launches to date in order to determine all flight and significant pre-flight anomalies.

With respect to organization and management relationships, it appeared that the responsibility and authority of the 6555th ATW was more clearly defined and understood by both the Wing and SSD personnel than that of the 6595th ATW. The 6555th personnel felt that they had the full responsibility and authority to conduct space launches at AMR in accordance with Program requirements without excessive program office interference in their activities. On the other hand, the 6595th ATW has had to organize project offices as counterparts to SSD program offices to act as a "buffer" between the program offices and minimize interference with the launch element.

The range support at AMR is a much cleaner operation than that at PMR because of the complex scheduling and coordination problem imposed on the

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6595th ATW at PMR. This situation has been further aggravated due to program offices submitting Program Requirement Documentation directly to the Range and bypassing the 6595th ATW.

There is considerable difference in the launch control and checkout equipment at the two locations. AMR has manually operated R and D type of equipment while PMR has automatic equipment. Because of this basic difference in support equipment, it is not considered feasible to make checkout procedures identical at the two locations; however, essentially the same checks are performed at both places. Furthermore, it is not considered practical nor economical to replace existing equipment for the sole purpose of standardization in order to make checkout procedures identical. However, there is some obsolete equipment at AMR which should be replaced with more modern equipment, such as the LOX loading system.

A significant difference in the equipment and procedures between the two launch sites is the existence of a gyro laboratory at AMR which gives this launch base the capability to check the Atlas flight control systems to a much greater degree than is possible at PMR. While the evidence is not yet conclusive, it appears that this capability provides AMR operations with a slightly greater probability of mission success than at PMR. Further investigation has already been initiated to look into the flight control system tests and quality control procedures at the factory in order to determine if a gyro laboratory should be installed at PMR.

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PART I

STATEMENT OF THE PROBLEM

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I. STATEMENT OF THE PROBLEM.

To identify and review major differences in equipment, procedures, and management structure which now exist between AMR and PMR Atlas/Agena Space launch operation. To evaluate these differences with the objective of determining their effect on the probability of success of the mission and to submit recommendations relative to standardization of organization, equipment and procedures which appear warranted from a cost/effectiveness standpoint. (See Tab VI for letter of direction)..

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PART II

GROUND RULES

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II. GROUND RULES.

A. Due to the wide variation in mission test philosophy and hardware between Atlas R and D missile operations, Atlas/Mercury/Centaur operations, and Atlas/Agena operations, it was concluded that little, if anything, could be gained from an overall Atlas launch base evaluation. This study, therefore, considers only Atlas/Agena space launch operations at the two bases since the Air Force Atlas space program is heavily oriented toward this booster combination.

B. Because of the wide variation in payload at the two launch bases, no effort was made to evaluate payload launch base operations. This effort, therefore, is limited in scope to an analysis of launch base operations from the arrival of the Atlas and Agena on the base through the ascent phase of launch.

C. In conducting a review of Atlas/Agena launches at the two bases, it was concluded that the flight failure analysis would be more revealing if it included all Atlas/Agena Launches regardless of whether the overall mission was successful or not. This analysis therefore considered all anomalies which occurred regardless of whether or not these irregularities were detrimental to the flight.

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PART III

APPROACH TO THE PROBLEM

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III. APPROACH TO THE PROBLEM.

A. At the direction of the Commander, SSD, a Space Launch Survey Team was established to conduct this analysis. The survey team then made visits to both launch bases to obtain the necessary information for this study. At each location, the survey team covered the following:

1. A detailed review with ATW personnel of their organization structure, methods of management, functional relationships with their ranges, and method of control of the space launch operation.
2. A comprehensive review with both military and contractor personnel of the entire Atlas and Agena launch base operation. This review included checkout and test functions, launch operations, and general test philosophy.
3. A detailed tour of launch complexes and checkout facilities was taken at each base. This included a review of all equipment located on the pad, in the blockhouse, and at the MAB. This checkout and launch equipment was then reviewed with contractor and military launch base personnel to identify the differences between the two locations.

B. The survey team then obtained copies of flight test reports for all Atlas/Agena launches made to date. Each of these reports was reviewed in detail and all flight anomalies and significant preflight anomalies were identified. (See Tab IV for summary of each flight)

C. Using the anomaly data and the information obtained on launch base equipment and checkout procedure differences, a study was made to determine insofar as possible, whether or not the associated base checkout and launch procedures or associated equipment could be correlated with each failure or anomaly. In each case, both launch base procedures were reviewed to determine if one of the two procedures appeared to be preferential in dealing with the particular anomaly being considered. Conclusions were then drawn from the above study for use in the overall evaluation.

D. The survey team was then divided into four study groups from analysis of the launch base differences in the following four areas:

1. ATW Organization and Management
2. Checkout and Launch Operations
3. Checkout and Launch Equipment
4. Comparison of Range Support

E. At the conclusion of the above analysis, and subsequent evaluation by the survey team as a whole, conclusions were drawn and the recommendations shown in Part III of this report were derived.

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PART IV

ANALYSIS AND EVALUATION

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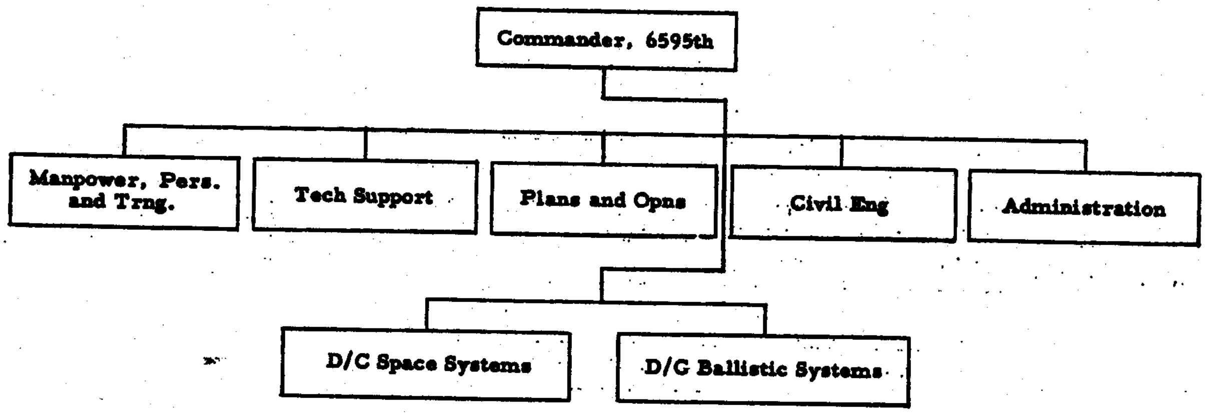
IV. ANALYSIS AND EVALUATION.

A. Organization and Management of Aerospace Test Wings.

1. 6595th Aerospace Test Wing.

a. The 6595th ATW is assigned to SSD, but is operationally responsive to the Commanders of BSD and SSD.



b. The Wing is divided into two operational elements, Deputy for Space Systems and Deputy for Ballistic Systems.

c. Wing staff and support elements provide services to the Deputy Commanders and are responsive to their requirements.

(1) Administrative services provides normal administrative services for the wing such as security, document control, orders, etc.

(2) Tech Support provides materiel, communications, pad safety, range instrumentation, range coordination, etc.

(3) Plans and Operations includes a Wing scheduling section which provides early program integration.

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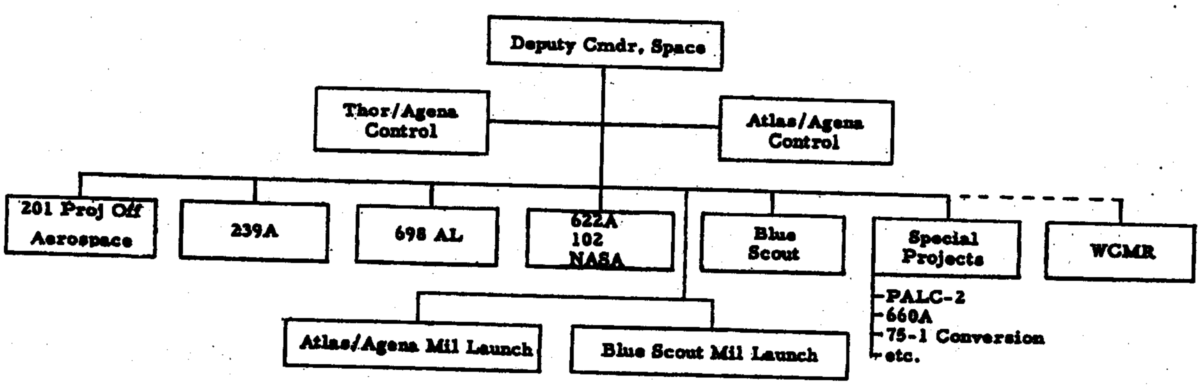
(4) Civil Engineering provides surveillance of new facility construction and technical services on technical facility modifications.

(5) Manpower, personnel and training includes personnel assignments, classification and training for approximately 300 airmen assigned.

d. The 6595th ATW Deputy Commander for Space Systems is functionally organized as follows:



(1) The organization is program or project oriented. Aerospace functions as a part of certain project offices. The project officers in each office are responsible for:

(a) Project documentation including review of Program Requirement Documents (PRD), preparation of Operational Requirements (OR) and also insures submission of Pad Safety and Flight Safety Reports to range, etc.

(b) Chair Flight Test Working Group (FTWG), or Launch Test Working Group (LTWG), which is a management tool used by the 6595th ATW at PMR. This group is designated by Program Configuration i.e., 201, 239A, etc. The membership includes the ATW Project Officer (Executive Chairman), Aerospace Corporation, when contractually involved (Technical Chairman), each associate contractor, USAF Quality Control, management agencies of programs involved, 6595th ATW, 1

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STRATAD and PMR. The FTWG publishes two documents on each missile operation. The Launch Test Directive (LTD) includes a description of the vehicle test sequence, the launch restraints and milestone countdowns. The second document is the Flight Test Report (FTR) published some fourteen days after each flight. It is a fairly comprehensive review of the vehicle history at PMR including the flight results based on data available within approximately ten days following launch.

(c) Exercise technical test control over MAB launch vehicle checkout.

(d) Coordinate all program matters between VAFB personnel and SSD Program Offices.

(e) Exercise overall management of Program office matters at VAFB, including master schedules.

(2) Management of the associate contractor's operations at PMR is accomplished by project office and control branch personnel with the assistance of Western Contract Management Region Representatives. Aerospace Corporation furnishes technical support for the Special Projects Program only.

(3) New project officers are established when the scope of a particular program indicates a need.

(4) The Thor/Agena and Atlas/Agena control branches perform indentical functions. The functions of these branches are:

(a) Exercising technical test control overall pad tests, both airborne and aerospace ground equipment (AGE).

(b) Scheduling all tests on the pads and rescheduling tests as required.

(c) Coordinating and monitoring all modifications and the demonstration associated with both ground and airborne equipment.

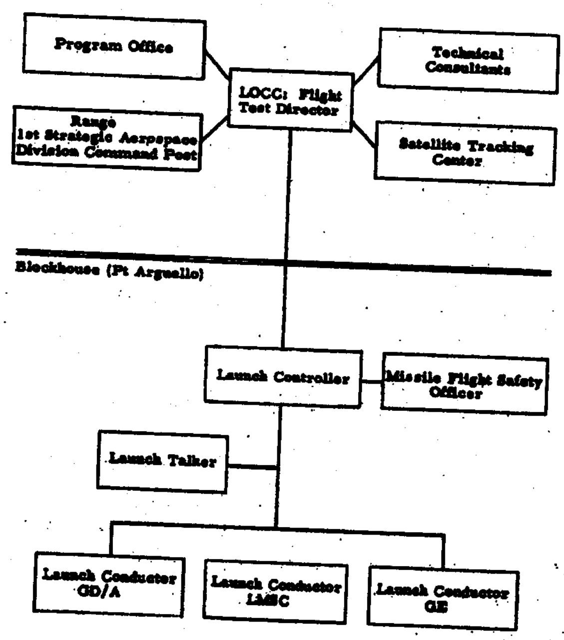
(d) Conducting the launch countdown with full responsibility for the proper verification that all systems are ready for launch.

(e) Reporting all deficiencies noted in the tests and demonstrations through the project officer to the Program Office.

(f) Defining test objectives for system validation tests.

(g) Assisting contractors in detailed test procedure preparation for system level testing to insure the launch vehicle will perform the flight test requirement specified.

e. The 6595th ATW Atlas/Agena Launch Organization is as follows:



(1) The Launch Operations Control Center (LOCC) is the focal point of all information flow concerning the launch operations at VAFB. This is the launch headquarters for the Wing Commander, and is manned by him or his representative, the project officer, the integrating contractor (LMSC or Aerospace) and a representative of the respective Program Office. All problems not directly affecting the vehicle countdown are coordinated here. The LOCC therefore, acts as a filter for the blockhouse thus relieving the launch controller of the added burden of coordinating problems external to the vehicle countdown.

(2) The Launch Controller is the 6595th ATW officer appointed by the Commander to conduct the countdown. He is responsible for launch vehicle readiness and is responsive only to the Commander and the Missile Flight Safety Officer (MFSO).

(3) The Launch Conductors are responsible to the Launch Controller for the readiness of their respective systems. They are required to report all matters affecting the launch readiness of their systems to the Launch Controller, who in turn provides the necessary direction for actions to be taken.

f. <u>Relations with contractors.</u>

(1) Because of the charter of this Wing, an extraordinary amount of control of contractor activity is exercised.

(2) A basic Wing policy is that the contractor will be responsive to Wing management. This requires that the Wing technical management be based on a good logical engineering approach, putting emphasis on personnel capabilities.

(3) The present relations are harmonious and based on a mutual respect between contractor and military personnel.

g. <u>Relations with outside agencies.</u>

(1) The wing is responsible for technical test control. This includes definition of individual test objectives, scheduling, conduct, and acceptance of tests.

On the other hand the respective program office is responsible for technical direction and systems engineering to provide the hardware with which the flight test may be achieved. On occasion, conflict between wing and program office has resulted due to overlapping of functions particularly in the area of test control. Unrealistic scheduling by program offices of launch base activities has had an unfortunate effect also.

(a) VAFB contractor organizations are contractually authorized a two shift operation (nominal eight hour days). However, for over a year the VAFB contractors have been committed to a 24 hour, seven day a week operation in support of program office requirements. This means that for an extended period of time some personnel have been subjected to 12 hour days, seven days a week. This practice must inevitably result in some deterioration of human factors.

(b) High intensity schedules induce a reluctance to slip the schedule for reruns of unsatisfactory tests. This shortcutting of normal test procedures, waiver of specifications and/or requirements may result in a deterioration of reliability.

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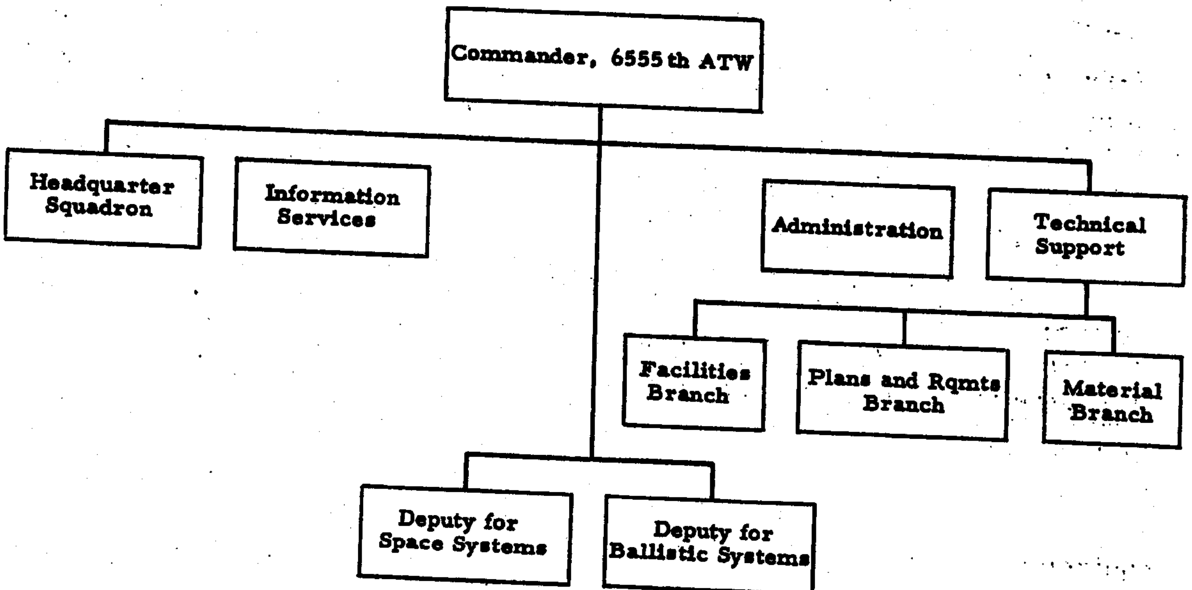
2. The 6555th Aerospace Test Wing.

a. The 6555th ATW is assigned to BSD, but is operationally responsive to the Commanders of BSD and SSD, and is the single point of contact with AMR for BSD and SSD on operational matters.



b. The Wing is divided into two operational elements, Deputy for Space Systems and Deputy for Ballistic Systems. The Wing Commander considers his primary function to be the exercise of technical test control over the flight test phase of BSD and SSD programs at AMR.

c. Wing Staff and supporting elements include material, administration, facilities, plans and programs, information services, and a headquarters squadron. These supporting elements provide services to the Deputy Commanders and are responsive to their requirements. Early participation by Wing elements in the planning phase of all programs requiring launches from the AMR is essential in the providing of adequate and timely support as the program progresses. Conduct of flight test operations is the function of the Wing and the delegation of this authority is essential. The detailed scheduling of checkout and launch of each vehicle following its arrival at AMR is done by the Wing with due consideration for launch windows, overall program schedules, and the desires of the program offices concerned.

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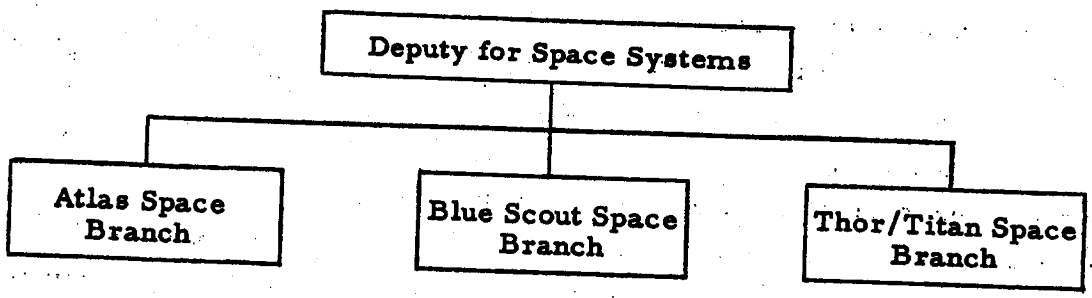
d. The Deputy for Space Systems has three branches which are organized according to the type of booster used in the space programs, i.e., programs using Atlas boosters are handled in the Atlas Space Branch. The number of programs using or planning to use the Atlas Launch Vehicles and the limited personnel resources of the Wing were prime factors considered in organizing the branches according to launch vehicle configuration rather than by programs.



e. The Atlas Space Branch is divided into two sections-Plans and Requirements (P and R) and Flight Test Operations (FTO). The P and R section is physically located at PAFB and the FTO section at Cape Canaveral. Each officer in P and R is assigned the responsibility to handle all requirements on one or more programs. Each officer in FTO is assigned a physical area and/or a vehicle system to control. The Chief of FTO is responsible for the checkout of all Atlas Launch Vehicles. The Chief of the Atlas Space Branch is responsible to the Deputy for Space Systems for the test phase of all Atlas boosted programs assigned by SSD.

f. Space programs in the early planning phase are coordinated with AMR by a support element of the Wing-Plans and Programs Branch. When a program reaches the stage where project control is required, it is assigned to the branch handling the specific booster. The P and R section of this branch then handles all program documentation to obtain the support required at AMR. The office works closely with the SSD program offices in the preparation of the PRD. The AMR considers the Commander of the 6555th ATW as the Director of SSD and BSD test programs at AMR, and requires his signature on all requirements documents.

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g. The Flight Test Working Group (FTWG) is a management tool used by the 6555th ATW at AMR to control the checkout of vehicle systems. The FTWG is also designated by configuration, i.e., Atlas/Agena. The membership includes representatives of the Atlas Space Branch (Executive Chairman), Aerospace Corporation, when contractually involved (Technical Chairman), each associate contractor, USAF quality control, management agencies of programs involved, and AMR (Pan American World Airways program management representative). The FTWG publishes two documents on each missile operation. The Flight Test Directive (FTD) is a compilation of the checkout procedures, by contractor designation, that are to be accomplished on each vehicle system from receipt through launch. Launch restraints and milestone countdowns are also included. The concurrence of each associate contractor and approval by the Wing is shown by signoff before publication. The second document is the Flight Test Report (FTR) published some fourteen days after each flight. It is a fairly comprehensive review of the vehicle history at AMR including the flight results based on data available within approximately ten days following launch.

h. Management of the associate contractors' operations at AMR is accomplished by branch personnel with the assistance of the USAF secondary contract administration personnel at AMR (AFSCTSO) and the Aerospace Corporation as contractually committed. Aerospace Corporation furnishes technical support in two areas to the 6555th ATW:

(1) Project type support (confined to those programs contracted for) consisting of System Engineering and Technical Direction (SE and TD) on new systems and program peculiar modifications to standard boosters. They also provide technical consultant services on other project matters.

(2) Technical staff type support is provided across the board and includes such items as range capabilities, range safety studies, research on special technical problems, and review of program requirements for consistency.

i. No military launch capability exists for Atlas Space boosters at present. The requisite manpower and training program for an Atlas/Agena capability on Complex 13 has been submitted to SSD. If approved, the military launch team will be integrated with the Atlas Space Branch.

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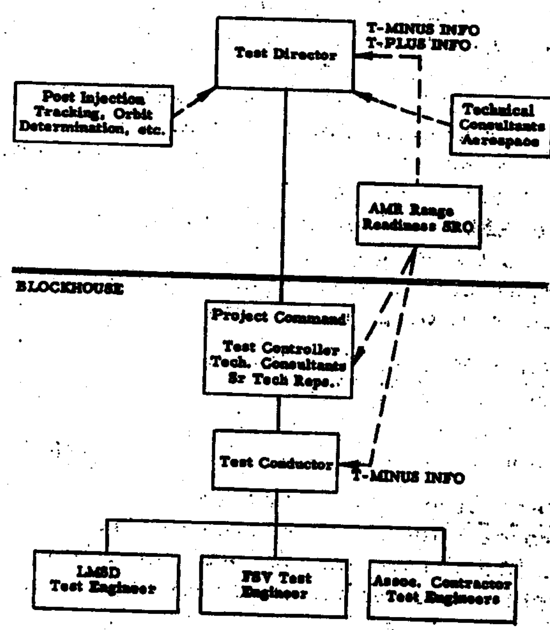
j. The 6555th ATW Launch Organization is as follows:



(1) Test Director - The Test Director, AMR, is responsible for the mission objectives. He receives inputs from the Test Controller, the Superintendent of Range Operations, and Test Directors at locations outside AMR, and evaluates the data to determine if mission objectives can be met. His decisions will be guided by operating priorities, launch operating procedures, and his knowledge of the limitations of available test resources and funds. He informs the Test Controller of the necessity for launch countdown holds to be imposed for mission objective reasons. The Test Director will be a 6555th Aerospace Test Wing officer specifically designated by the Wing Commander on those programs for which SSD is the management agency. The Test Director may be a representative of the Management Agency or an officer of the 6555th Aerospace Test Wing for those programs under a Management Agency other than SSD.

(2) Technical Consultants - (Test Director) are missile and technical contractor, and military representatives, requeste by the Test Director to make appropriate recommendations concerning the mission status and readiness and attainment of mission objectives.

The following personnel are located in the blockhouse.

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(3) Test Controller[1] - The Test Controller is the 6555th Aerospace Test Wing Officer specifically designated by the Wing Commander to act in that capacity for any specified test. He has overall supervision of the launch operation and exercises technical test control. He is responsible to the Test Director for the readiness of the launch vehicle and the launch complex and for regulating the launch countdown progress as necessary to correlate with the status of other mission support facilities outside the AMR. When problems arise that could affect launch or mission objectives he will utilize the Project Command organization to determine the appropriate course of action that will be passed to the Test Director for decision.

(4) Other Project Command Members - (Project Command consists of the Test Controller assisted by the Senior Technical Consultant Representative and the Airframe Contractor's Senior Technical Representatives.)

(5) Test Conductor - The Test Conductor is the booster airframe contractor representative specifically designated to fulfill this duty for any specified test. In the launch vehicle assembly checkout and launch operations, the Test Conductor will operate in accordance with directions and operating procedures of the Flight Test Directive and the Countdown Manual. He will make launch vehicle system operational decisions that (a) do not compromise the launch schedule, vehicle flight readiness or launch test objectives; and (b) do not interfere with other programs that share facilities and/or equipment. The Test Conductor receives information on the range status to support the launch operations directly from the Superintendent of Range Operations (SRO). He is directly responsible to the Test Controller for the conduct of the overall countdown. If problems of compromise or interference arise, he will report them to the Test Controller.

(6) LMSD Senior Test Engineer is the upper stage Airframe Contractor representative specifically designated to fulfill this duty for any specified test. A Senior Test Engineer has operational supervision of his portion of the countdown and is responsible to the Test Controller for the technical readiness of his stage. However, during the countdown he will report to the booster Test Conductor.

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1 The 6555th Test Wing Launch Organization provides for two basic functions, Project Command and Launch Operations. The Test Controller has overall supervision of the launch operation and exercises technical test control.

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(7) Final Stage Vehicle Test Engineer is the spacecraft contractor representative specifically designated to fulfill this duty for any specified test. The FSV Test Engineer has operational supervision of his portion of the countdown. The FSV Test Engineer reports to the Test Conductor but is responsible to the Test Controller for the technical readiness of the spacecraft.

(8) Other Associate Contractor Test Engineers are the system contractor representatives specifically designated to fulfill this duty for any specified test. The Associate Contractor Test Engineers coordinate and direct all test operations according to the applicable procedure or countdown, and have operational supervision for their portion of the test operations. The Associate Contractors Test Engineers report to the Test Conductor but are responsible to the Test Controller for the technical readiness of the applicable system.

(9) Technical Consultant (Test Controller) is the technical contractor's representative specifically designated to fulfill this duty for any specified test. The Test Consultant coordinates problem areas with the Test Conductor, LMSD Test Engineer, FSV Test Engineer and other Associate Test Engineers, receiving and evaluating the technical adequacy of their proposed solutions and making appropriate recommendations to the Test Controller to assure capability of attaining mission objectives and assuring vehicle technical readiness.

3. Differences between the 6555th and 6595th Aerospace Test Wing Organizations.

a. The major organizational difference between the two Wings is that the 6555th ATW is organized according to launch vehicle configuration and may handle several projects while the 6595th organization is generally project oriented. The 6555th Branch Chiefs have the responsibility for the total SSD mission at AMR. The 6595th ATW Project Offices exercise overall management of the effort at PMR, including master schedules. In the 6595th ATW the technical test control responsibility is split between the Launch Control Branches and the Wing Project Offices. The Wing Project Offices exercise technical test control over MAB checkout and chair the Flight Test Working Group. After the launch vehicle is moved to the pad the Launch Control branch exercises technical test control over all tests including both airborne and AGE.

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The 6595th ATW is forced into this project or program type of organization because of the nature and complexity of the SSD Programs and the program offices proximity to VAFB. The 6595th ATW feel that they must have project officers as counterparts to the SSD program offices to keep SSD project officers "off the back" of the working element.

b. The DCAS Liaison Office at Pt Mugu is designated as the single point of contact with PMR. This office is not a part of the 6595th ATW organization. The 6595th ATW deals directly with PMR at Pt Arguello on many matters, and SSD deals directly with the DCAS Pt Mugu Liaison Office without going through the 6595th ATW and thereby leaving the 6595th ATW unaware of what is going on.

c. The 6555th ATW has a Plans and Requirements element which is responsible for coordinating Program Requirement Documents (PRDs) between the range and SSD. In the 6595th ATW, this function is the responsibility of the project offices, but in some cases, documentation goes directly to the range and by-passes the Wing project offices. A much more effective control of requirements could be achieved if all Program Requirements Documentation (PRDs) were submitted to the 6595th ATW for processing through to the PMR.

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B. Atlas/Agena Checkout and Launch Operations.

1. Test Philosophy for Atlas Vehicles.

a. AMR was created as an R and D missile test base. The test equipment created for this mission was manually operated and specifically designed so that quantitative data could be gained to establish realistic limits for parameters to be tested. This quantitative data was required for further development of the system. PMR was created as an operational site. The checkout equipment created to perform this mission was "Go-No Go" automatic type to be operated by technician type "Blue Suit" personnel with contractor assistance. The equipment was not designed to be used for future development of the system.

b. Originally at AMR, each subsystem was checked, including a composite test in the MAB, and repeated many tests after booster erection. Today, the MAB is only used on a limited basis. At PMR, the Atlas/Agena operation was created as an operational site and operates under the concept that the booster should be "pad ready" before erection. Because of this concept, a MAB containing automatic checkout equipment is utilized.

c. The gyro laboratory for Flight Control Checkout at AMR is there only because of the R and D philosophy at AMR. The 6595th at PMR does not have this laboratory capability. Trouble and failure records at PMR and AMR indicate the rejection rates of autopilots is excessively high.

2. Test Philosophy for Agena.

a. Basically, there are two philosophies which determine the amount of checkout the Agena Vehicle is subjected to in the MAB:

(1) Limited checkout is accomplished in the MAB. The amount of checkout is dependent upon the program test plan for the vehicle i.e., AMR-Ranger, PMR-Midas.

(2) The other philosophy is to introduce the Agena to the payload for the first time at the MAB. This requires performing the final integrated systems run in a systems checkout complex at the MAB, i.e., PMR-Special Projects.

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3. Detail Checkout and Launch Operations - Atlas.

a. AMR Checkout Procedures.

(1) The 6555th ATW does very little checkout of an Atlas booster prior to erection on the pad. When the booster arrives, it is processed through receiving inspection at the MAB. Outstanding engineering changes may be incorporated at this time. Some subsystem components are removed and checked out on equipment similar to that used at the factory. Flight control subsystem components are an example of this procedure. Components are reinstalled on the booster at the pad and rerun on later systems checkouts.

(2) Pad checkout procedures are arranged and sequenced in order to meet certain milestones. The first set of procedures are for pad refurbishing. These insure that the ground equipment is functioning properly and that equipment replaced during refurbishing operations is properly installed. Upon completion of pad readiness procedures, the booster is erected. The next group of procedures are run in parallel, but are arranged to lead up to two major tests. The mechanical and leak tests are run to ready the booster for the dual propellant loading (DPL). The electrical and electronic procedures prepare the booster for the Flight Acceptance and Compatibility Tests (FACT). At this point, the Atlas booster is ready for mating of the Agena Vehicle and Joint FACT (J-FACT). Following the J-FACT, the Agena is demated for installation of ordnance and to run time-limited validations levied by specification. Subsequent testing does not verify all circuits violated by demating.

(3) At AMR, what was originally the vertical composite test has been combined with the umbilical eject test. This combination is now known as the FACT test. This test has the advantage of actually ejecting umbilicals at the same sequence time as during launch.

b. PMR Checkout Procedures.

(1) At PMR the MAB is utilized to accomplish as many tests as possible prior to moving the booster to the launch pad. The booster is processed through receiving inspection, outstanding engineering changes

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are accomplished, and checkout starts in the MAB area. Leak tests are accomplished, hydraulic systems are filled and bled, calibration and alignment checks are made. Autopilot, propellant utilization (PU), and guidance systems are checked using APCHE.

(2) At the pad, another series of tests are run which prepare the booster for Simulated Flight Test and Propellant Tanking Test. Simulated Flight Test is conducted after the Agena/Booster has been mated. The Atlas umbilical eject test developed at AMR is not performed at PMR at the present time. The Agena is then demtaed for compliance with time-limited validation of components and installation of ordnance. During this demated period, the Atlas Dual Propellant Tanking (DPL) takes place. Following the DPL, the Agena is remated to the Atlas. Subsequent testing does not verify all circuits violated by the the demate.

4. Detail Checkout and Launch Operations - Agena B.

a. The test procedures for the Agena differ from AMR to PMR basically because of the pad configuration. After completion of MAB tests, compatibility tests are run at the pad at AMR and PMR. After demating, the close proximity of the MAB to the pad at AMR, allows the Agena vehicle to return to the MAB for final test and servicing. The wing at PMR uses a shed at the pad and services and tests the Agena in a horizontal position with blockhouse control and test equipment.

b. AMR Ranger Checkout Procedures.

(1) MAB Tests.

(a) Receiving Inspection.

Subsystem A	1.	Turbine Exhaust Duct Alignment
	2.	Horizon Sensor Alignment
Subsystem B	1.	Leak Tests Including Propellant Bulkhead
Subsystem B and C	1.	Destruct System Find Check
Subsystem D	1.	Validation and Final Adjustment

Subsystem H — 1. Vehicle Instrument Calibration; 2. Beacon Validation

Total of 8 Work Days

(b) After pad operations, cited below, the vehicle is returned to the MAB for installation of ordnance, servicing, repetition of test imposed by time compliance specification, and returned to the pad.

(2) Pad Operations.

(a) The AMR umbilical tower does not have the capability of being lowered to the pad deck to accommodate vehicle-blockhouse checks with the vehicle in the horizontal position. Hence, all vehicle-blockhouse tests must be accomplished with the Agena mated to the erected Atlas.

(b) The AMR Agena vehicle is easier to check out, in that there is no vehicle command system involved, as compared to the complex command and control system required for the PMR vehicles.

c. PMR Checkout Procedures.

(1) Midas MAB Tests.

(a) Receiving Inspection.

Subsystem A	1. Fit Check Booster Adaptor
Subsystem B	1. Leak Tests Including Propellant Bulkheads
Subsystem B and C	1. Destruct System Checkout
Subsystem D	1. Validation and Final Adjust

Total of 6 1/2 Work Days

(2) PMR Special Projects MAB Tests.

See Tab V

Total 63 Work Days (First Vehicle)

(3) Pad Operations.

(a) The PMR PALC-1 umbilical masts are hydraulically actuated and can be lowered to the pad deck to permit vehicle-blockhouse checking in the horizontal position. However, the present design for PALC-2 is similar to AMR, i. e., the umbilical tower can not be lowered.

(b) Because of the fact that the wing at AMR has operated with the nonlowerable mast, there is considerable conflict of opinion as to the necessity of having the vehicle-horizontal-on-the-pad checkout capability.

5. Major Differences in Atlas/Agena Checkout and Launch Operations.

a. The 6555th and 6595th wings have several major differences in test philosophies and procedures:

(1) The Atlas checkout equipment at AMR is "manually" operated equipment, designed to obtain maximum data by engineering type personnel; whereas, the checkout equipment at PMR is the automatic programmed type "Go/No-Go" equipment supplemented by land line instrumentation.

(2) At AMR, the Missile Assembly Building (MAB) is used for receipt and inspection of the booster. The booster is checked out on the pad. At PMR, utilizing the MAB, essentially all subsystems are exercised before sending the booster to the pad for erection.

(3) The AMR wing does all Agena horizontal work in the MAB. The wing at PMR has two systems: Special Project vehicles are completely (including payload) system checked in the MAB before being sent to the pad for booster mating. All other vehicles are checked in a "test shed" at the pad in a horizontal position using "blockhouse" launch control and test equipment.

(4) AMR Test Wing personnel do not participate in the detail checkout with the contractor to the same extent as PMR personnel. PMR Test Wing personnel participate in detail checkout with the contractor in most every phase of test operations.

(5) System parameters checked at AMR are very similar in most respects to those at PMR. The difference in test equipment, AMR versus PMR, dictates the use of different detailed procedures at each place to accomplish these checks.

(6) At AMR there is a gyro laboratory for Atlas flight control checkout; the 6595th ATW does not have this capability.

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C. Atlas/Agena Checkout and Launch Equipment.

1. The testing philosophy established by the Ranger, Midas, and Special Projects programs vary widely because of program and mission peculiar requirements. The Ranger program uses the Agena for ascent only. The Midas program uses the Agena throughout its orbital life and the Special Projects Program's uses the Agena in a manner which falls in between the Ranger and Midas. The Atlas test philosophy does not vary with the program, as does the Agena, but rather, varies with the range from which it is launched. At the PMR, the testing is done on the operational Atlas "D" concept and is therefore accomplished with automatic equipment. At the AMR, the testing philosophy is still R and D and, therefore, the manual type of checkout equipment is still utilized.

a. Atlas/Agena Equipment at AMR.

(1) At the AMR, the Atlas Booster checkout and launch equipment is of the R and D manual type. In the MAB, receipt, inspection, and flight control component checkout is performed. The AMR has a gyro lab in which the booster flight control components are individually verified. After erection of the Booster on the pad, the manual launch control equipment, in conjunction with landlines and contractor operated ground telemetry stations recording the readout, are used to verify the booster systems. During countdown of the booster with the AMR equipment, actions such as opening and closing valves and power switching are not accomplished automatically.

(2) The checkout equipment located at AMR, to satisfy the Ranger requirement, is subsystem checkout items located in the MAB. The launch control equipment is essentially the same as that located at PMR with additions or deletions being made to satisfy mission requirements. See Tab II for a summary of above.

[redacted]

b. Atlas/Agena Equipment at PMR.

(1) At the PMR, the Atlas booster checkout and launch equipment is of the automatic type. In the MAB the Automatic Programmed Checkout Equipment (APCHE), which utilizes prepunched card decks, is used to check out the Atlas booster subsystems for verification of a pad-ready booster. After erection at the pad, another set of APCHE is used to verify the booster systems with the pad equipment. At such time as the booster is ready for launch, the Automatic Launch Control Equipment performs the countdown and launch.

(2) The Checkout equipment required to meet the Special Projects requirements consists of subsystem and integrated system check-out items. This equipment performs confidence and compatibility checks on the Agena vehicle prior to mating with the Atlas for the entire vehicle system check at the pad. The equipment required for the Midas vehicle consists of subsystem checkout equipment only. Both Special Projects and Midas use essentially the same launch control equipment with additions or deletions being made to meet the mission peculiar requirements.

c. Differences in Equipment at AMR and PMR.

(1) The differences in the equipment utilized for verification tests, confidence checks, and launch of the Atlas/Agena vehicle have been categorized by listing them within the functional tests performed as shown below.

Location	Equipment	
	AMR	PMR
MAB		
1. Component Tests	Atlas Flight Control (Gyro Lab)	None
2. Subsystem Tests	None	Atlas Booster (APCHE)
3. System Tests	None	Agena Special Projects (Integrated System Test Complex).

[redacted]

[redacted]

Location: PAD	Equipment: AMR	Equipment: PMR
Multiple System Test		None
4. Dual Propellant Loading	Atlas Load Cells Pump Fed LO^2 Loading	Pressure Fed LO^2 Loading
5. Launch Countdown	Manual R and D (Atlas)	Automatic Operational (Atlas)

(a) The first difference in equipment is the Gyro Lab at AMR. Within this lab, the Gyro Cans, Programmer and Servo Cans are checked out individually as is done at the factory. The tests performed in the lab will give quantitative data and show gains and drifts. At PMR, the Flight Control System is checked out in the MAB while still on the booster. This checkout is done using APCHE, which will compare the output signal with tolerances and read out a "go" or "no-go" condition. There is no way in which gain or drift values can be obtained, as the gyro cans cannot be tilted or tipped while in the booster as they are on tables in the AMR Gyro Lab. The analysis of flight data shown in Tab I reveals that in the Booster Flight Control Package, there has been only one class 3 anomaly in five flights at AMR. On the other hand, there have been four class 2 anomalies and one complete flight failure in eight flights at PMR.

(b) The second difference is the APCHE for subsystem checkout in the MAB at PMR. The 6555th at AMR does not have this equipment or anything analogous to it for subsystem checkout in the MAB. Subsystem checkout is not performed in the MAB at AMR, but instead, at the pad with the manual launch control equipment and landlines.

(c) The third difference is the Special Projects Agena Integrated Systems Test Complex. This complex is used to perform an integrated system checkout with the Agena vehicle, payload vehicle, and payload. At the AMR the Agena acts only as a second boost stage vehicle and does not require an integrated system test complex.

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(d) The fourth difference is in the propellant loading systems at AMR and PMR.

1. At AMR the propellant loadcells are used to record the weight of the booster while propellants are being loaded aboard. This system is used in conjunction with the probe filling system. Loadcells are not available for use at PMR.

2. At PMR there is a pressurized LOX Loading System which has the capability of topping against flight or third stage pressure. At AMR the LOX loading system is a pump type which has been the cause of many problems and countdown holds. Also, this system does not have the capability to top against flight pressure which is a very desirable capability from the standpoint of propellant utilization and booster performance.

(e) The fifth difference is the launch control equipment in the blockhouse. At AMR, this equipment is the manual R and D type with which all countdown functions must be accomplished manually. At PMR, the launch control equipment is automatic. These countdown functions are accomplished automatically by use of logic ladder sequencing.

[redacted]

D. Range Support of Launch Operations.

1. AMR Range Support.

a. General Discussion.

The Atlantic Missile Range (AMR) is managed and operated by the Air Force Missile Test Center at Patrick AFB. The Center presently has a contract with Pan American World Airways (PAA) to provide support for range operations. PAA subcontracts a portion of this support to Radio Corporation of America (RCA).

b. Supporting Functions.

A listing of the support functions provided by AMR in launches of Atlas/Agena vehicles is shown in Tab III. The methods established for obtaining this support are well defined and relatively clean cut. Documentation between the Wing and AMR provides for a continuous flow of information which allows the Wing, as a range user, to be aware of the specific support items the range is planning to provide for a given launch. Coordination between the Wing and AMR appears complete and relatively straight forward. The support in the case of Atlas/Agena has covered most of the items needed. Since a PAA representative is a member of the Atlas/Agena Flight Test Working Group, the range has a capability of providing fast reaction for this support.

c. Problems in Range Support.

There can be little argument that the type of range support provided by AMR is in general, effective and well managed. However, in some areas , it has not provided the complete and timely support necessary for launch operations. For instance:

(1) Development of range instrumentation at AMR has not kept pace with program requirements. The necessity of using missile program funds to pay the lion's share of development costs for systems such as Mistram does not allow the range adequate lead time to provide timely support.

[redacted]

(2) Adequate storage facilities for Agena fuels have not been provided by the range.

(3) The lack of adequate calibration lab support in the past forced GD/A and LMSC to acquire their own calibration lab capability. This capability has now been acquired by AMR.

(4) There have been definite problems in obtaining satisfactory analysis of fluid chemicals (fuel hydraulic fluids) by the AFMTC Chemical Laboratory, i.e., scheduling, analysis procedures, cleanliness standards, etc.

2. PMR Range Support.

a. General Discussion.

Obtaining range support at PMR is more complex than at the AMR. While PMR (Navy) is charged with the overall responsibility of range operation, support of Atlas/Agena space launches is divided between the Strategic Air Command (SAC-VAFB), PMR, 1369th Photographic Squadron, 6594th ATW, and the 6595th ATW.

b. Supporting Functions.

A listing of the support functions and the organization providing this support is shown in Tab III.

c. Problems in Range Support.

Since the Wing must utilize the resources of more than one organization in obtaining the required range support, a heavy requirement is placed on the 6595th ATW for time-consuming coordination. In addition, SSD program offices sometimes do not coordinate range requirements documents with the Wing before submitting them to the PMR. This has, at times, resulted in support requirements being levied on agencies incapable of providing this support.

3. Differences between AMR and PMR Range Support.

a. As shown in Tab III, there is a substantial difference in sources of range support at the two launch bases. AMR has, through a subcontractor contractor organization, provided the Wing with virtually all-inclusive range support. On the other hand, the PMR Atlas/Agena launches are

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supported from multiple resources. If it is assumed that it is mandatory for the operator of a national range to provide complete support to using agencies, then the Navy's support is inadequate. On the other hand, it should be pointed out that the overall support by all agencies at the PMR has been at least as good as that provided by AMR.

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PART V

CONCLUSIONS

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V. CONCLUSIONS.

1. It appears that the latest management philosophy is to project space programs from the highest organizational level instead of delegating the responsibility and authority to the implementing organization. The nature and complexity of space programs and proximity of SSD to PMR has influenced the 6595th ATW to organize project offices as counterparts to SSD program offices. This puts the 6595th ATW Commander in the undesirable position of having a boss in each space program.

2. The DCAS Liaison Office at Point Mugu does not efficiently represent the 6595th ATW in the day-to-day contacts with PMR. It would appear that the organizational structure at AMR, where the wing operates as the single point of contact with the range, is a far more effective method of dealing with a national range.

3. The by-passing of the 6595th ATW in the processing of program requirements documentation to the PMR causes considerable confusion in the Test Wing/Range management relations.

4. The re-verification, at specified intervals, of many of the Agena subsystems dictates checkout sequence and results in redundant testing.

5. It would be an asset if the umbilical eject test developed at AMR, was incorporated in the simulated flight test at PMR.

6. Because of basic differences in support equipment, mission requirements, and range requirements, it is not feasible to make checkout procedures identical even though essentially the same checks are performed at both bases, nor is it considered practical or economical to do so.

7. In-flight performance of the Atlas flight control system has been more successful on Atlas/Agena launches at AMR. While the evidence is not yet conclusive it appears that this is the result of the capability at AMR to validate the flight control system to a greater degree than is now possible at PMR.

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8. The AMR manually operated checkout and launch equipment is capable of performing the same functions as the automatic equipment at PMR.

9. The antiquated LOX loading system at AMR has caused problems and countdown delays.

10. Although the range support at AMR appears to be a much cleaner operation as far as the 6555th ATW is concerned, essentially the same support is provided at PMR, but is a more complex scheduling and coordinating task for the 6595th ATW.

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PART VI

RECOMMENDATIONS

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VI. RECOMMENDATIONS.

1. SSD should establish a written policy (charter) clearly defining the responsibility and authority of the 6595th ATW to direct and conduct space launches at PMR. This policy should be disseminated to all Program Offices and rigidly inforced.

2. The DCAS Liaison Office at Point Mugu should be made a part of the 6595th ATW.

3. All range requirements should be submitted to the PMR through the 6595th ATW.

4. The Atlas umbilical eject test should be incorporated into the simulated flight test at PMR.

5. SSD should take action with The Lockheed Missile and Space Company to re-evaluate the requirement to revalidate subsystems at periodic intervals in order to eliminate or extend these time intervals.

6. SSD should direct LMSC to take the necessary action to eliminate the routine demating of the Agena from the Atlas once it has been mated.

7. As a result of this study, the SLV III (Atlas Booster) Office is currently investigating the factory flight control test and quality control procedures to determine the necessity of installing a gyro laboratory at PMR and their findings should be implemented.

8. Considering cost/effectiveness, it is recommended that the manually operated launch control and checkout equipment at AMR be retained.

9. Updated LOX loading systems with a third stage pressure topping capability should be installed on AMR Atlas/Agena stands.

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PART VII

APPENDIX

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TAB I

ANALYSIS OF FLIGHT TEST REPORTS

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TAB I

ANALYSES OF FLIGHT TEST REPORTS

VEHICLE	PROPULSION	ELECTRICAL	GUIDANCE	FLIGHT CONTROL	COMMUN.	HYDRAULICS	AGE: AGENA	AGE: ATLAS	REMARKS
AMR									
29D	----	AG_1^z Missile borne range safety system	----	----	AG_3^z instr. and AT_3^z telem.	----	Acid filter made of wrong material	----	Generally Poor Contractor Quality Control
45D	----	----	$AT_3^{w,y}$ improper programming and ground guidance	AG_3^z oscillations during burn phase	AG_3^z telemetry	---- ---- ----	Trouble with acid fill system	---- ----	2 Range holds
111D	AG_1^z manifold pressure switch on 2nd burn	----	----	----	----	----	----	Trouble with LOX transfer unit	----
117D	----	----	AG_1^z -Gyro spin motor failure	AT_3^z programmer ran too early	----	----	Oxidizer fill valve stuck	----	Poor factory Q.C. of flight control system
121D	----	----	AT_1^v No guidance discreets	----	----	----	----	LOX transfer unit problems - umbilical troubles	----

AG = Agena
AT = Atlas
Class 1 = Flight Failure
Class 2 = Could have caused Flight Failure
Class 3 = Anomalies

v = Random Failure
w = Procedure Difficulty
x = Equipment Difficulty
y = Organization Difficulty
z = Design Deficiency

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TAB I

ANALYSIS OF FLIGHT TEST REPORTS (Cont'd)

VEHICLE	PROPULSION	ELECTRICAL	GUIDANCE	FLIGHT CONTROL	COMMUN.	HYDRAULICS	AGE: AGENA	AGE: ATLAS	REMARKS
PMR 57D	----	----	AT_2^{VW} No guidance discreets	----	----	AT_3^{V} pressure drop off	Umbilical failure of nitrogen quick dis-connect	----	----
70D	----	----	AT_3^{V} Rate Beacon failure	----	----	AT_3^{S} Accumulator failure	----	----	Range safety hold power failure
97D	----	AT_2^{V} inverter power surge	----	AT_2^{S} programmer recycle	----	----	----	1007 umbilical dropped out	LOX leak in booster. LOX probe failure
106D	----	----	----	----	----	----	----	AT_1^{S} umbilical did not pull	LOX probe failure
105D	AT_2^{V} vernier bleed valve failure	----	----	AT_2^{V} Gyro amplifier failure. AT_3^{V} staged early.	AG_3^{V} Telemetry	----	----	----	----
108D	----	AT_3^{S} Harness problem	----	AT_1^{V} Gyro and auto-pilot failure	----	----	----	----	Range hold. Factory Q. C. insufficient
114D	AT_3^{S} propellant depletion switch cir-cuit failure	AT_3^{V} power inverter failure	----	AT_2^{S} programmer failure	----	----	----	----	----

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TAB II

COMPARISON OF ATLAS/AGENA TESTS - AMR vs PMR

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TAB II

COMPARISON OF ATLAS/AGENA TESTS - AMR vs PMR

MAB TESTS	AMR Atlas	AMR Agena	PMR Atlas	PMR S. P. Agena	PMR Midas Agena
Receipt and Inspection	X	X	X	X	X
Component	X	0	0	0	0
Subsystem	#	X	X	X	#
System	#	0	0	X	0

PAD Tests

AMR Nomenclature	PMR Nomenclature	AMR Atlas	AMR Agena	PMR Atlas	PMR S. P. Agena	PMR Midas Agena
Subsystem Combats. (Launch Control and Airborne Integration)	Same	X	X	X	X	X
Booster FACT (Subsystem Integration)	System Compatibility (Subsystem Integration)	X	0*	X	X	X
Composite (J-FACT) (Agena Simulated Flight) (Atlas Dual Propellant) (Tank)	System Demonstration (Agena Simulated Flight) (Atlas Dual Propellant) (Tank)	X	X	X	X	X
Preflight (R-Days)	Preflight (R-Days)	X	X	X	X	X
Countdown	Countdown	X	X	X	X	X

* Difference in procedure only

NOTE: Payload equipment is not considered.

X denotes equipment available and used

0 denotes equipment not available

# denotes equipment available and not used

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TAB III

COMPARISON OF RANGE SUPPORT

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TAB III

COMPARISON OF RANGE SUPPORT

ACTIVITY	AMR	PMR
Data Reduction	AFMTC and Contractors	Contractors
Telemetry	AFMTC and Contractors	6594th ATW and Contractors
Metric Data	AFMTC	6594th and PMR
Missile Propellants	AFMTC	SAC and LMS C
Operational Communications	AFMTC	SSD
Administrative Communication	AFMTC	SAC
Industrial Power (MAB)	AFMTC	SAC
Critical Power	AFMTC	PMR and GDA
Pad Safety Control	AFMTC	6595th ATW
Flight Safety Control	AFMTC	PMR
Range Scheduling	AFMTC	SAC and PMR
Radio Frequency Control	AFMTC	PMR
Engineering Photography	AFMTC	1369th Photographic Squadron
Documentary Photography	AFMTC	1369th Photographic Squadron
Complex Security	AFMTC	SAC
Emergency Medical Aid	AFMTC	PMR and SAC
Food Services	AFMTC	SAC
Chemical Laboratory	AFMTC	SAC and Contractor
Machine Shop Services	AFMTC	Individual Contractors

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TAB III

COMPARISON OF RANGE SUPPORT (Cont.)

ACTIVITY	AMR	PMR
Administrative Office Space	AFMTC	SAC
Laboratory Space	AFMTC	6595th (MAB)
Supply of Standard USAF Stock Items	AFMTC	SAC
Roads and Road Maintenance	AFMTC	SAC and PMR
Vehicle Transportation to the Pad	Contractors	Contractors
Pad Fire Trucks	AFMTC	SAC and PMR

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TAB IV

FLIGHT TEST REPORT SUMMARIES

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AMR-1

LAUNCH SUMMARY

The first countdown attempt resulted in the launch of the MIDAS I Booster/Satellite combination from Complex 14, AFMTC at 1225:29.73 EST on 26 February 1960. The primary objective was to place an experimental surveillance satellite in orbit. The flight was unsuccessful in that the MIDAS satellite was not placed in orbit.

The launch and flight was completely successful through vernier phase. At this time the booster/satellite combination had obtained the correct velocity and position. At approximately 259.6 seconds[1] (0.13 seconds after the satellite separation discrete) all transmissions with the satellite were interrupted. At this time tracking and telemetered data indicated an apparent explosion within the flight adapter, followed by an abrupt deceleration and tumbling of the booster airframe. The most probable cause was either inadvertent activation of the satellite destruct charge or a random failure of the satellite high pressure gas spheres which resulted in a hypergolic explosion of the satellite propellants.

1 All flight times in this report are referenced to Range Zero Time, 1225:29.00 EST.

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AMR-2

LAUNCH SUMMARY

The successful launch of the MIDAS II Booster/Satellite combination was accomplished on the first attempt, on 24 May 1960 at 1736:45.76 GMT. The primary objective was to place an experimental surveillance satellite in orbit. The launch was successful and orbit was achieved. Orbital objectives were only partially met due to tumbling of the vehicle and later deterioration of the airborne communication systems.

Launch was from Complex 14, AFMTC (AMR), and was without incident. The flight proceeded as expected; booster engine staging and Satellite separation occurred at the nominal times and with a minimum of perturbations. Proper Satellite orientation was achieved and the orbital boost sequence was fully satisfactory. Reorientation sequence appeared normal; however, later data indicate that the vehicle was not stabilized as it passed over Station 12 (Ascension Island).

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AMR-3

LAUNCH SUMMARY

The Ranger Flight Vehicle RA-1 (Atlas/Agena-B/Spacecraft RA-1) was launched during the fifth attempt, on 23 August 1961 at 0504:10 EST from Complex 12, AMR. The primary system objectives were to inject the Spacecraft into the prescribed orbit, demonstrate overall vehicle compatibility, and demonstrate that ground equipment and procedures were capable of launching, controlling, and providing data from the Ranger vehicle within the necessary time restrictions. These objectives were achieved with two exceptions, the Spacecraft was not injected into the prescribed orbit, and all data from the Ranger Vehicle was not provided within the required times. Injection was not achieved because the Agena-B second burn did not occur due to a component failure in the propulsion system.

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AMR-4

LAUNCH SUMMARY

The Ranger Flight Vehicle RA-2 (Atlas/Agena-B/Spacecraft RA-2) was launched on the fourth attempt, on 18 November 1961 at 0312:21 EST from Complex 12, AMR. The primary system objectives were to inject the Spacecraft into a highly elliptical earth orbit, evaluate vehicle compatibility demonstrate that ground equipment and procedures were adequate for launching within the time restrictions, and demonstrate the capability to acquire and provide data from the Ranger system.

Due to a malfunction of the Agena-B roll gyro, stability was lost shortly after Atlas/Agena-B separation. There was a premature cutoff of Agena-B second burn and the Spacecraft was not placed in the proper trajectory. The premature cutoff was apparently caused by conditions associated with the instability.

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AMR-5

LAUNCH SUMMARY

The Ranger Flight Vehicle RA-3 (Atlas/Agena-B/Spacecraft RA-3) was launched on 26 January 1962 at 1530:11 EST, from Complex 12, AMR. The purpose of the flight was to inject the Spacecraft into a moon-coincident trajectory.

Due to a malfunction of the first stage airborne guidance equipment, the trajectory and sequence of events were outside tolerances for a moon impact trajectory. The Spacecraft passed within approximately 22,000 miles of the moon and entered into a solar orbit.

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PMR-1

LAUNCH SUMMARY

Agena 2101/Atlas 57D was launched from Pad 1 of the Pt. Arguello, Pacific Missile Range PALC I at 1233:28.28 PST on 11 October 1960. The primary objective of the launch, to place the Agena satellite into a circular orbit at an approximate altitude of 261 nmi, was not achieved. Agena 2101 failed to orbit because of a malfunction during liftoff, when the vehicle half of the nitrogen-freon umbilical release coupling was torn from the vehicle, permitting the control gas to excape.

First stage boost of the Atlas ICBM was satisfactory, although the fine guidance and command discretes were missing. The backup programmed guidance within the Atlas performed successfully to obtain a satisfactory velocity and position at vernier engine cutoff.

Separation of the Agena from the Atlas was completed successfully, followed by an uncontrolled coast period. Engine start was normal, but because the vehicle attitude was uncontrolled in roll, the engine cycled between its gimbal stops under hydraulic attitude control. Although the Agena engine provided sufficient thrust for orbital injection, the thrust direction was uncontrolled, precluding orbital attainment.

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PMR-2

LAUNCH SUMMARY

Agena 2102/Atlas 70D was launched from Pt. Arguello Pad 1 at 1222:19.1 PST on 31 January 1961. The primary launch objective, to place a classified satellite into a circular orbit at an altitude of approximately 261 nmi, was achieved.

The Atlas-powered boost phase of the flight was satisfactory. Discrete functions were properly commanded by the Mod II guidance, however, some erratic steering commands were transmitted before sustainer engine cutoff and no steering commands were transmitted during vernier engine solo when the guidance range rate confidence flag was lost. Coast apogee conditions were near-nominal although some question presently exists regarding the magnitude of the coast apogee velocity. Structural vibrations were noted in two different periods during the boost phase. Atlas system performance was otherwise normal.

Separation of the orbital stage from the booster was completed satisfactorily. Following a normal coast period, Agena engine ignition and cutoff were properly effected. The velocity gain during Agena engine operation and consequently the orbital injection velocity were high primarily because of an incorrect integrator setting. The orbital injection conditions were otherwise near-nominal.

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PMR-3

LAUNCH SUMMARY

Agena 1201/Atlas 97D was launched from Pt. Arguello, Complex 1, Pad 2, at 0811:46 PDT on 12 July 1961. The primary launch objective -- to place the Agena-B into near polar orbit at an altitude of approximately 1850 miles -- was fully achieved.

The launching of this vehicle was accomplished on the third attempt, a countdown on 2 July having been cancelled because of an Atlas LOX leak, and one on 10 July having aborted because of premature ejection of a booster umbilical after Atlas engine start. This vehicle represented the first Atlas/Agena launch from Pt. Arguello, Pad 2, and the first vehicle equipped with the Agena-B orbital stage: the two previous vehicles of this type launched from Cape Canaveral utilized the Agena-A orbital stage. Also, this was the first Agena to use the second engine burn technique to place the satellite into extended circular orbit.

Liftoff and Atlas boost were normal except for three problems: (1) overload of the missile inverter after booster jettison (this apparently caused recycling of the flight programmer; (2) shift and noise of the error demodulator output (EDO) of the propellant utilization system to the LOX rich limit between T+42.9 sec and T+59.4 sec; and (3) frequency shift (13.5 Mc/sec) of the pulse-beacon magnetron at T+94 sec, which reduced the signal strength 20 to 25 db below nominal. Atlas boost and performance of the Mod II guidance, which transmitted steering orders and commands well within tolerance despite the marginally received signal, were not adversely affected by these problems.

The Agena subsystems operated properly to inject the vehicle into the desired orbit. Initial injection was made to a transfer ellipse orbit, with a successful second engine burn (18 sec nominal duration) at apogee sending the vehicle into near circular orbit at a mean altitude of 1832 nautical miles.

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Two significant problems were encountered: Spurious outputs from the horizon-sensor during first burn and an indicated high rate of control-gas consumption between first burn termination and first pass intercept at Vandenberg Tracking Station indicate an attitude control problem; and there was an apparent velocity-meter error of approximately 7.2 fps.

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PMR-4

LAUNCH SUMMARY

Attempted launch of the combined Agena 2120/Atlas 106D vehicle was made from Pt. Arguello Complex 1, Pad 1, 9 September 1961 at 1228:27.10 PDT. The primary launch objective -- to place the Agena satellite into near polar orbit at an altitude of 251.7 nmi -- was not achieved due to the vehicle destroying itself on the launch pad shortly after liftoff.

The cause of the vehicle destruction is attributed to a delayed release of Atlas umbilical P1003. This late release permitted a normal "Commit Stop" signal to enter the Atlas which returned the missile power from internal to external after the vehicle had risen from the launch pad.

The transfer of power to external caused the Atlas engines to shutdown when P1003 was finally released and power was lost. The subsequent impact of the vehicle with the pad resulted in explosions and fire which destroyed both the Atlas and the Agena.

Damage to the pad, though extensive, was confined primarily to plumbing, wiring, electrical equipment, and light hardware. Estimated pad rehabilitation time is seven weeks.

[redacted]

[redacted]

PMR-5

LAUNCH SUMMARY

A launch vehicle consisting of Agena B satellite 1202 and Atlas booster 105D, was launched from Point Arguello, PMR, on 21 October 1961.

The primary launch objective, that of placing the satellite carrying an infrared payload in a polar circular orbit approximately 2100 nautical miles above the earth was only partially accomplished, because the Agena's eccentricity and orbit-plane inclination were out of tolerance, due to Atlas roll-control failure. Control was accomplished following Atlas boost and two Agena boost phases, despite difficulties arising from loss of Atlas roll control.

Launch and boost were normal until approximately 185 seconds, when the Atlas booster lost roll control to the vernier engines. As a result, the combination completed approximately 8-1/2 clockwise roll revolutions before Agena separation from the booster. Following separation, the Agena pitched over in the wrong plane due to the Atlas roll error. The Agena's horizon sensor sensed the earth's horizon, and the satellite stabilized in the proper attitude but with an error in the yaw plane. Consequently, the orbit plane attained was inclined 95 degrees instead of the planned 90 degrees. An excessive amount of control gas was used by the Agena during this corrective maneuver.

Agena-engine operation and injection into the orbit transfer ellipse were normal. During the period from first-to-second-engine operation, rapid limit cycles appeared on all axes and the expenditure of control gas was excessive.

Second-engine operation was normal, as evidenced by telemetry data secured by SAS (AMR-13).

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Following second-engine operation, Agena orientation to the nose-down attitude occurred, and the solar arrays extended.

During Pass 1, attitude perturbations existed, and control gas was expended. The satellite's instability, primarily in pitch motion, was verified to have a 92-second period. Subsequently, sun-tracking requirements imposed upon the solar arrays were in excess of design capability, and one array failed to track the sun properly after Pass 4. As a result, the electrical power expended was greater than that generated. After Pass 56, power supplies were depleted and all equipment shut down, except the HEPDE, which was powered by a separate supply.

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PMR-6

LAUNCH SUMMARY

A vehicle, composed of an Agena B orbital stage (serial No. 2202) and an Atlas missile booster stage (serial No. 108D), was launched from Pt. Arguello Pad 1 on 22 November 1961. The primary launch objective, to place the Agena satellite into near circular orbit at a mean altitude of approximately 172 nautical miles, was not achieved: an Atlas flight control problem prevented orbital injection of the Agena.

The launching was accomplished on the second attempt, a countdown on the previous day having been cancelled due to an Atlas integrated start system problem. Liftoff was normal, with the liftoff tone generated at 1245:47.49 PST.

The Atlas boost phase of flight was unsatisfactory. Two malfunctions were encountered.

(1) Booster engine cutoff and staging occurred prematurely due to erroneous action of the staging backup circuit (acceleration switch). This malfunction alone was not critical with respect to the final mission objectives.

(2) Complete loss of pitch attitude control during the last 66 sec of Atlas powered flight. This malfunction was critical in that it resulted in an orientation at Agena separation which made it impossible for the Agena to attain orbital conditions.

The Agena subsystems attempted to perform their respective functions after separation. Orbital injection, however, was precluded because the Agena thrust vector was misdirected. Trajectory data at 470 sec, the time of final loss of track by the VERLORT radar, indicated that after approximately 126 sec of thrust the Agena's velocity was less than that at engine ignition and its direction was approximately 17 deg below horizontal.

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PMR-7

LAUNCH SUMMARY

A vehicle composed of an Agena-B orbital stage (serial No. 2203) and an Atlas missile booster stage (serial No. 114D), was launched from Point Arguello Complex 1, Pad 2, on 22 December 1961. The primary launch objective--to place the Agena satellite, equipped with a recoverable payload capsule, into a stable polar orbit--was achieved. However, the orbit attained was significantly different than that desired due to an excess velocity, resulting from a delayed Atlas sustainer engine shutdown.

Launch was accomplished on the first attempt. Countdown was initiated at 0050 PST, 22 December, and liftoff occurred at 1112:33.55 (PST), after three holds totaling 42 minutes to resolve technical difficulties.

The Mod II guidance system properly formulated and transmitted correct steering orders and commands to the Atlas missile. The Atlas, however, failed to respond to the sustainer engine cutoff (SCO) discrete command which allowed the sustainer engine to operate until propellant depletion. This resulted in an excessive coast apogee velocity. Except for the SECO malfunction, Atlas performance was satisfactory although problems were encountered with: (1) 3-4 cps oscillations starting at T+90 sec; (2) excessive engine compartment ambient temperatures; (3) a slightly low phase A a-c voltage, and (4) a telemetry transducer power supply malfunction near the end of powered flight.

The performance of all Agena subsystems was adequate to achieve orbit; however, difficulties in either the S-band beacon or the VTS radar resulted in premature loss of track. In addition, problems were encountered with the Agena oxidizer tank relief valve during the Atlas boost phase and spurious horizon sensor outputs for a short period after injection.

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TAB V

SPECIAL PROJECTS MAB TEST SCHEDULE

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TAB V. SPECIAL PROJECTS (SCHEDULE OF TASKS).

TASK NR.	DESCRIPTION	PROCEDURE NR.
1.	Receiving Inspection	
2.	SS/C Power-On Checks	S068945-234
3.	SS/D Validation Checks	S335484-242
4.	Vehicle Complex 10 Compatibilities	
5.	Ready Run	S332518-012
6.	Retrofits and Mods	
7.	SS/B Leak Checks	S412262-2218 S412262-2221 V20000014
8.	Adaptor/Agena Fit Checks and Destruct	S412283-2129 S412623-231
9.	Fly Away and Umbilical Drop Tests	1519027 1516256
10.	Alignments	S324972-2121
11.	Hydraulic Power Package Verification Test (BRAYCO)	V2000064
12.	SS/B Low Pressure Checks	S412262-224
13.	MAB Simulated Flight Preps	S332518 845209 (GE)
14.	Final Ready Run and Evaluation	S332518-012
15.	MAB Simulated Flight	845209 (GE)
16.	Simulated Flight Evaluation	
17.	Final MAB Preparations	

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TAB VI

GENERAL ESTES LETTER OF DIRECTION

SURVEY TEAM SPECIAL ORDERS

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19 March 1962

Atlas Launches at AMR and PMR

Major General O. J. Ritland
Commander, Space Systems Division (AFSC)
AF Unit Post Office
Los Angeles 45, California

Dear Ossie

1. One of the major points made by your Launch Analysis Task Force in a recent briefing to me was the impact on pad time and costs attributable to lack of standardization of equipment and procedures. Lack of standardization is conducive not only to excessive costs, but also tends to affect the success of the launching.

2. It appears to me that differences in hardware, procedures and organizational arrangements that relate to Atlas launchings at AMR and PMR may be affecting significantly the degree of success of launchings at these two locations. In fact, some recent data which I have examined indicates a slightly greater percentage of successful launches at AMR than at PMR. In this event, it would appear desirable to achieve, to the extent feasible, a standard way of "doing business" which would be common to the two locations and which would employ the best features of the two current systems of operations.

3. In view of the above, it is requested that you arrange for a comprehensive analysis and evaluation of this area with the following objectives in mind:

a. To review all of the elements, including hardware, procedures and organization, involved in the launch process at AMR and PMR for the purpose of determining significant differences between the two organizations.

b. To analyze and evaluate these differences for the purpose of identifying those for which one of the alternate ways appears to be preferential in terms of the probability of success of the mission.

c. To determine on the basis of this analysis and evaluation whether or not these differences should in any way contribute to a higher level of success or reliability at either one or the other of the two launch sites. (Effects of differences of national range facilities of AMR and PMR should be taken into account in this connection.)

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d. To prepare recommendations regarding any standardization between the launch sites in terms of equipment, procedures, etc. which, on a cost/effectiveness basis might appear warranted toward the objective of higher reliability levels and further to prepare recommendations as to any additions in equipment or changes in procedures at the national ranges which would serve these same ends.

4. For some time, a launch analysis task force has been in session to examine means of reducing launch cost and launch pad time. It is possible that the investigations mentioned above might be undertaken as an additional task by this group. In any event, it is of vital importance that whatever group conducts the investigation be so organized as to conduct those efforts in an atmosphere of maximum objectivity. It is requested that you inform me by return memorandum of the general plan of action which you contemplate and the approximate date at which a meaningful study may be completed.

Sincerely,

HOWELL M. ESTES, JR.
Lieutenant General, USAF
Deputy Commander for Aerospace Systems

[redacted]

[redacted]

HEADQUARTERS
OFFICE OF THE DEPUTY COMMANDER AFSC
FOR AEROSPACE SYSTEMS
UNITED STATES AIR FORCE
Air Force Unit Post Office, Los Angeles 45, California

SPECIAL ORDER
M-74

28 March 1962

Under the provisions of DCASR 11-6, a Space Launch Survey Team is established for the purpose of analysis and evaluation of the differences in hardware, procedures, and organizational arrangements that relate to Atlas space launchings at Atlantic Missile Range (AMR) and Pacific Missile Range (PMR). Team will convene at the call of the Chairman. In the absence of the designated Chairman or Recorder, the senior member present at the meeting will act as Chairman and the junior member present will perform the duties of the Recorder. Duties of the members of this survey team will take precedence over all other assignments. Upon submission of the final Team report, and approval by the Commander, Hq DCAS (AFSC), the Team will be dissolved. The Recorder will notify the Chief, Office of Administrative Services, Hq DCAS (AFSC), when the Team is dissolved. Five members constitute a quorum. The following personnel constitute the Team:

*COL HENRY C MARSHALL, 10701A	Hq SSD, Chairman
*LTCOL TAYLOR B ZINN JR, A0407777	Hq 6555 ATW, Patrick AFB Florida, Member
*MAJ ROBERT H KNAPP, A0793511	Hq SSD, Member
*CAPT HOWARD G GLIEKE, A00942135	Hq SSD, Member
*CAPT JOHN B STURGES JR, 25448A	Hq 6595 ATW, Vandenberg AFB Calif, Member
*1STLT ANTHONY F SPOLIDORO, A05206780	Hq SSD, Member
1STLT RICHARD O GRANT, A03086656	Hq DCAS, Recorder
MR JACK WIEGAND	Aerospace Corp.

*With the concurrence of the respective Commanders.

FOR THE COMMANDER

OFFICIAL

LBERT T PA

Colonel, USAF

Ch e of Administrative Services

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NOTE: Mr. William L. Williams (alternate to Mr. Wiegand), Mr. S.R. Sartore (LMSC) and Mr. L. W. Standley (GD/A) assisted the team in the conduct of this study.

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SSVE-103
F-3/F-4

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SSVE-103

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