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Launch Test Directive

PROGRAM 162

CONTRACT AF 04(695)-233

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PROGRAM 162

LAUNCH TEST DIRECTIVE

CONTRACT AF 04 (695) - 233

1694

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This document supersedes Discoverer Flight Test Directive LMSC 445925-C. That document and its associated appendices and tabs should be destroyed in accordance with applicable USAF instructions.

Distribution - LMSC 223616-3

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FIGURES

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SECTION I

INTRODUCTION

1.1 CONTRACTUAL REQUIREMENT

Lockheed Missiles and Space Company (LMSC) has been assigned responsibility for technical direction of the Program 162, and for the publication of a Launch Test Directive (LTD) to cover each launch in accordance with the provisions of Air Force Contract 04 (695) -233. The LTD is distributed in accordance with directions issued by the 6595th Aerospace Test Wing.

1.2 PURPOSE

The purpose of the LTD is to provide a working document to define objectives, to set forth evaluation criteria and to delineate preparation and support requirements for the pre-launch and launch portion of the flight test. The LTD also provides vehicle and system information to enable more effective participation by support agencies and by the range in a countdown and launch.

1.3 ARRANGEMENT

The basic LTD document will remain substantially the same for all Program 162 launches. Data relating to individual flights will be issued under appropriate tabs as appendices to the LTD.

1.4 CHANGES

Changes are furnished to activities covered in the distribution list as they are published. Changes will be serially numbered and the change number and date of change printed on the change record sheet and on each new page issued for purposes of identification.

1.5 RELATIONSHIP TO SYSTEMS TEST OBJECTIVES (STO)

The LTD utilized the Systems Test Objectives, LMSC 448510-A, issued by LMSC, Sunnyvale as a source document for information and is in agreement with the objectives and general test specifications contained therein.

1.6 OTHER INFORMATION SOURCES

The 6595th Aerospace Test Wing, LMSC, Douglas Aircraft Company, Rocketdyne, Bell Telephone Laboratories, and other agencies provide information for inclusion in this document.

TEST OBJECTIVES

2.1 FLIGHT MISSION

The mission of all Program 162 flights covered by this document is to place satellites carrying designated test payloads on prescribed polar earth orbits and to recover a data capsule ejected from the orbiting satellite.

Program 162 will incorporate basic flight mission profiles as determined by the configuration and objectives of payload selected for evaluation.

2.2 DEFINITIONS

2.2.1 Primary Test Objectives Defined

A primary objective is one for which a test flight is undertaken and must not, therefore, be compromised by any discernible inadequacy of airborne or ground equipment, procedures or personnel. Status changes that jeopardize the accomplishment of a primary objective are sufficient justification to hold, recycle, or terminate the countdown.

2.2.2 Secondary Test Objectives Defined

A secondary objective is one which is of vital concern to the research and development of satellite systems and space technology, but not pre-requisite to the attainment of a primary objective. If the accomplishment of any secondary objective appears to be in jeopardy at any time prior to initiation of the booster automatic launch sequence, the countdown may be held or recycled to resolve the difficulty.

2.3 PRIMARY TEST OBJECTIVES

The primary objectives of each flight are:

To place a 162 Satellite, carrying a test payload and with a specified active orbital life capability, on a prescribed near-polar orbit.

To secure adequate telemetered data from the 162 Satellite during its active orbital life for determination of objectives achievement.

To recover a nose-cone capsule, ejected from the satellite by command, after one, two, three, or more lays of active orbital life.

2.4 SECONDARY TEST OBJECTIVES

Secondary test objectives are called out in the S.T.O.

2.5 VEHICLE PERFORMANCE

Vehicle performance necessary to achieve the objectives is set forth in the S.T.O.

SECTION III

ORGANIZATION

3.1 GENERAL INFORMATION

This section contains information relative to the certain activities, organizations, publications, and personnel connected with launch preparations and launch of the vehicle.

3.2 LAUNCH CONTROL ACTIVITIES

3.2.1 Headquarters, Air Force Space Systems Division, (AFSSD), Inglewood, California

Over-all control of the program is exercised by Headquarters, AFSSD, Inglewood, California through the System 162 Directorate.

3.2.2 6594th Aerospace Test Wing

The 6594th Aerospace Test Wing located at Sunnyvale is responsible for controlling and coordinating the tracking and vehicle operations during the orbital phase with assistance from the contractors. As System Test Controller, the 6594th ATW performs the following:

Operates the Satellite Control Facilities.
Approves the Orbital Test Directive.
Establishes local operating procedures.
Supports launch base with tracking and telemetry services for checkout, prelaunch countdown operations, the operational readiness of the tracking stations and supporting forces.
Transmits to the launch base a clearance to launch or a directive to hold.

3.2.3 6595th Aerospace Test Wing

The 6595th Aerospace Test Wing located at VAFB is responsible for prelaunch and launch phases of the system test operations with assistance from the contractors.

The 6595th ATW performs the following:

Negociates with PMR for range support.
Conducts launch countdown and launch phase of test.
Operates Launch Operations Control Center (LOCC).
Establishes local standard operating procedures.
Participates in preparation of system standard operating procedures.
Evaluates launch operations and recommends improvements.
Prepares and submits reports as required.

3.2.4 1st Strategic Aerospace Division, SAC

The Strategic Aerospace Division, with headquarters at VAFB, furnishes logistic support including weather forecasts and aircraft support.

3.2.5 Satellite Test Annex (STA)

The STA, located at Sunnyvale, monitors launch operations, coordinates other system functions with the launch activities, and controls the orbital phase activities of all tracking stations. It is manned by 6594th Aerospace Test Wing and LMSC personnel. Test direction and control of the STA is the responsibility of the Air Force Systems Test Controller, assisted by the LMSC Systems Test Director and technical staffs.

3.2.6 Pacific Missile Range (PMR)

The Pacific Missile Range is a Navy command with headquarters at Pt. Mugu. It provides downrange ship coverage, range safety, metric photography and frequency interference control for launches.

3.2.7 Orbit Test Working Group (OTWG)

The OTWG is composed of members from the 6594th Aerospace Test Wing, LMSC and associate contractors. The 6594th ATW furnishes the group chairman. The group is primarily concerned with Satellite Control Facility operation and those auxiliary facilities required for orbital test. It is responsible for review of system launch and orbit operations, coordination, effects of configuration changes, the resolving of problem areas through specific task assignments and for post flight operations evaluation. The group meets at Sunnyvale.

3.2.8 Launch Test Working Group (LTWG)

Headquarters AFSSD has assigned authority for launch preparation and countdown planning to the Launch Test Working Group (LTWG), which meets at VAFB. An officer attached to the 6595th Aerospace Test Wing serves as chairman of the group. The 6596th Instrumentation Squadron, Complex Safety Office, Range Support Office, PMR, LMSC/VAFB, DAC/VAFB, WCMR ITT Kellogg, Rocketdyne, BTL, furnish members to the LTWG. The LTWG is the approval authority for the Launch Test Directive, and the Countdown Manual.

3.2.9 Launch Operations Control Center (LOCC)

The LOCC is an Air Force Activity that exercises control and direction of countdown activities at VAFB. LMSC/VAFB assists the Air Force in LOCC operation.

SECTION III

ORGANIZATION (Cont'd)

3.3 LAUNCH PERSONNEL

3.3.1 General Information

Titles and broad statement of responsibilities of launch personnel are set forth in this sub-section.

3.3.2 Systems Test Controller, 6594th Aerospace Test Wing

The Commander 6594th Aerospace Test Wing or his delegated representative is the Systems Test Controller. The Systems Test Controller is stationed in the STA for launch. He coordinates the pre-launch preparations of the satellite control facility. He assumes operational responsibility of the vehicle at lift-off from the Launch Controller and exercises control during flight operations.

3.3.3 Systems Test Director

LMSC representative stationed in the STA for launch. He continuously monitors the countdown, launch and orbit operations and provides technical support to the System Test Controller.

3.3.4 Launch Operations Coordinator, 6595th Aerospace Test Wing

The Launch Operations Coordinator is an officer designated by the 6595th ATW stationed in the LOCC for launch. He exercises over-all direction of the launch area activities. This includes liaison with VAFB and PMR for launch support.

3.3.5 Launch Operations Director, LMSC, VAFB

The LMSC Launch Operations Director is the senior LMSC representative stationed in the LOCC for launch. He renders technical support to the Launch Operations Coordinator during countdown and launch at VAFB.

3.3.6 Launch Controller, 6595th Aerospace Test Wing

The Launch Controller is the 6595th Aerospace Test Wing Test Operations representative stationed in the Control Center. He directs pre-launch vehicle checkout and countdown and coordinates this activity with other elements of the system.

3.3.7 LMSC Launch Conductor

The LMSC Launch Conductor, stationed in the Control Center, directs Lockheed countdown activities according to the Countdown Manual. The LMSC Launch Conductor conducts main steps in the satellite vehicle countdown procedure, verifies their completion, requests necessary holds, and reports progress to the Launch Controller.

SECTION III

ORGANIZATION (Cont'd)

3.3.8 Douglas (DAC) Launch Conductor

The DAC Launch Conductor, stationed in the Control Center directs the DAC countdown activities according to the Countdown Manual. The DAC Launch Conductor conducts main steps in the booster countdown procedure, verifies their completion, requests necessary holds, and reports progress to the Launch Controller.

3.3.9 Bell Telephone Laboratories Test Conductor-BTL

The BTL Test Conductor directs BTL Guidance Equipment countdown activities according to the Countdown Manual. The BTL Test Conductor directs all guidance equipment (ground guidance and missile-borne guidance) readiness tests, verifies their completion, calls necessary holds, and gives final guidance system readiness for launch to the DAC Launch Conductor.

3.3.10 Launch Complex Safety Officer

Complex safety for the 75-X Complexes is under the control of the 6595th Aerospace Test Wing. The 6595th ATW complex safety control is exercised through the Launch Complex Safety Officer, supported by the 1st STRATAD. Complex safety information is provided in the "Pad Safety Report" published by LMSC. These documents include information and safety precautions relating to clearance distance, criteria, procedures, propellants, ordnance items and pressures for both booster and satellite. Launch recovery and abort procedures are briefly covered in the Countdown Manual and are more thoroughly set forth in separate DAC and LMSC publications for booster and satellite, respectively.

3.3.11 Missile Flight Safety Officer (MFSO)

Flight safety for the 75-X Complexes is under the control of the PMR Missile Flight Safety Officer (MFSO). The MFSO monitors the launch from the Range Operations Center, requests countdown holds for range clearance, and commands destruct of errant missiles.

Range safety information will be provided in the PMR Range Safety Plan and in an LMSC document entitled "Range Safety Report", issued by LMSC, Sunnyvale 35 days prior to launch. Late revisions are transmitted in a "Range Safety TWX" by LMSC, Sunnyvale. The report covers the nominal predicted flight, dispersion patterns and the assumed types of malfunctions that might occur during ascent phase to booster burnout. Additional DAC range information is contained in Douglas report SM-37963, DM-21 Range Safety System issued in November 1960.

SECTION III

ORGANIZATION (Cont'd)

3.3.12 Other Launch Personnel

The designations and tasks of other Air Force, LMSC, DAC, BTL and VTS personnel participating in launch preparations and launch at the launch complex are set forth in the Countdown Manual.

SECTION IV

CONFIGURATION

4.1 GENERAL CONFIGURATION

Systems configuration for Program 162 is set forth in the Systems Test Objectives, LMSC 448510-A. It is briefly covered in this section.

4.1.1 Vehicle Configuration

Vehicles for the 162 Program consist of DAC SLV-2 or SLV-2A boosters mated to LMSC S-01 or S-01A satellite vehicles equipped with recoverable payloads. The tabs indicate the serial numbers of the booster-satellite vehicle combination. Figures 4-1 and 4-2 show booster and satellite vehicle.

4.1.2 Launch Operations Complex

The VAFB complex has the following major launch preparation and launch facilities:

DAC Receipt, Inspection and Maintenance (RIM) Building for receipt, storage and pre-launch-pad checkout of the booster.

The Missile Assembly Building (MAB) for receipt, storage and pre-launch-pad checkout of the satellite vehicle.

The SS/L Laboratory Building for payload receipt, storage and pre-launch-pad tests.

Launch Complex 75-1 with Pads 1 and 2 and Launch Complex 75-3 with Pads 4 and 5. Each complex has a control center and AGE for remote control of vehicle servicing, checkout and launch.

4.1.3 Ground-Space Communications System

The ground-space communication tracking and data system serving the launch phase is composed of the following major facilities:

Vandenberg Tracking Station

BTL Ground Guidance Station

PMR Optical and Radar Tracking System

PMR Missile Flight Safety System

Downrange Telemetry Ship

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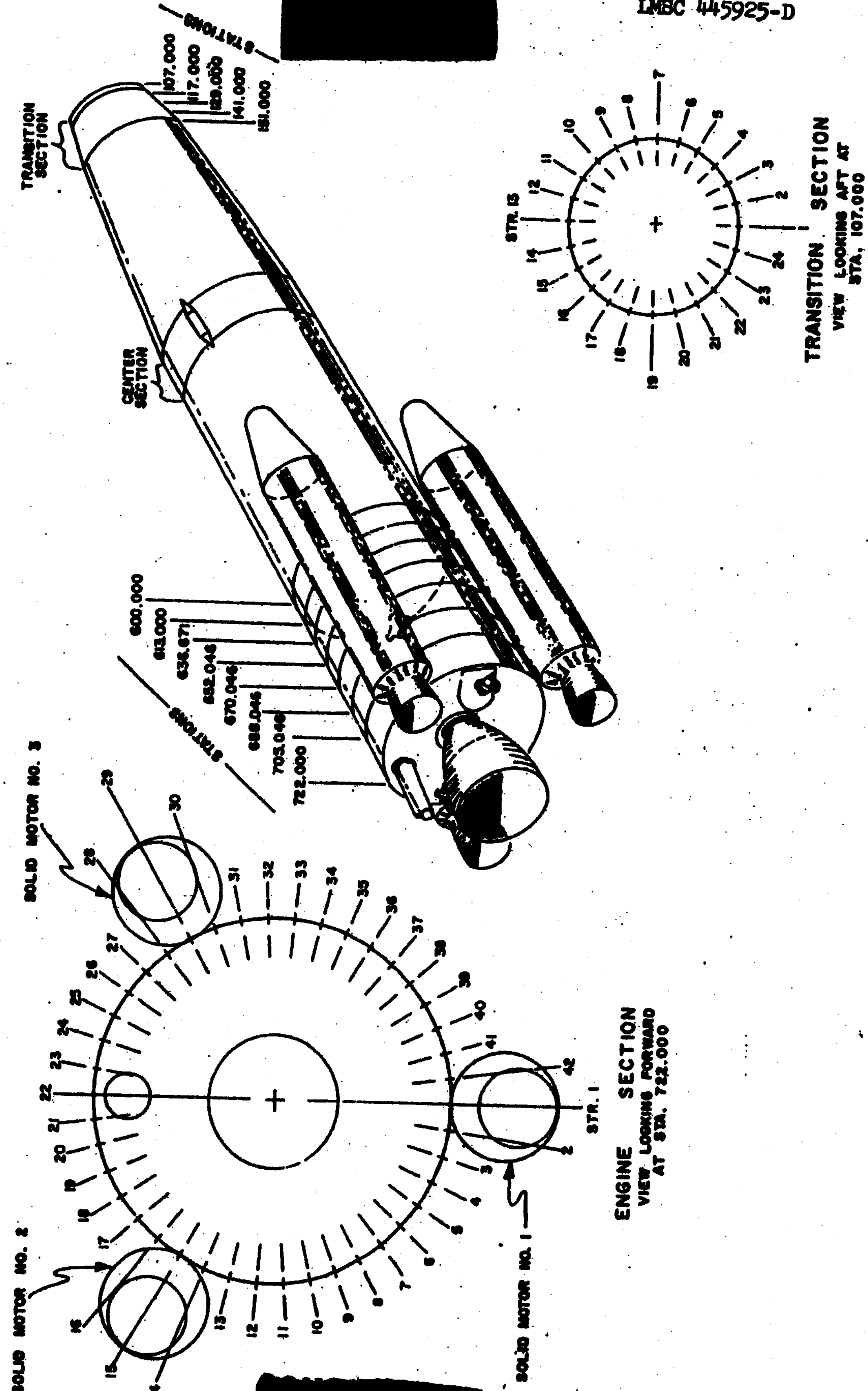

FIGURE 4-1

SLV-2A - BOOSTER

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Figure 4-2

S-01A VEHICLE

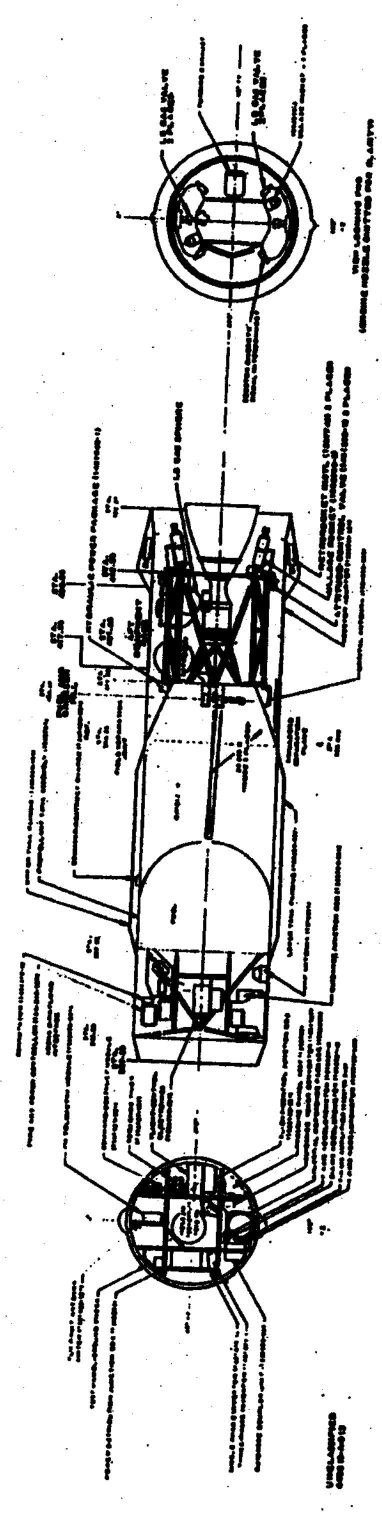

Figure 2-4 622A Agena D Model 30-205 Inboard Profile

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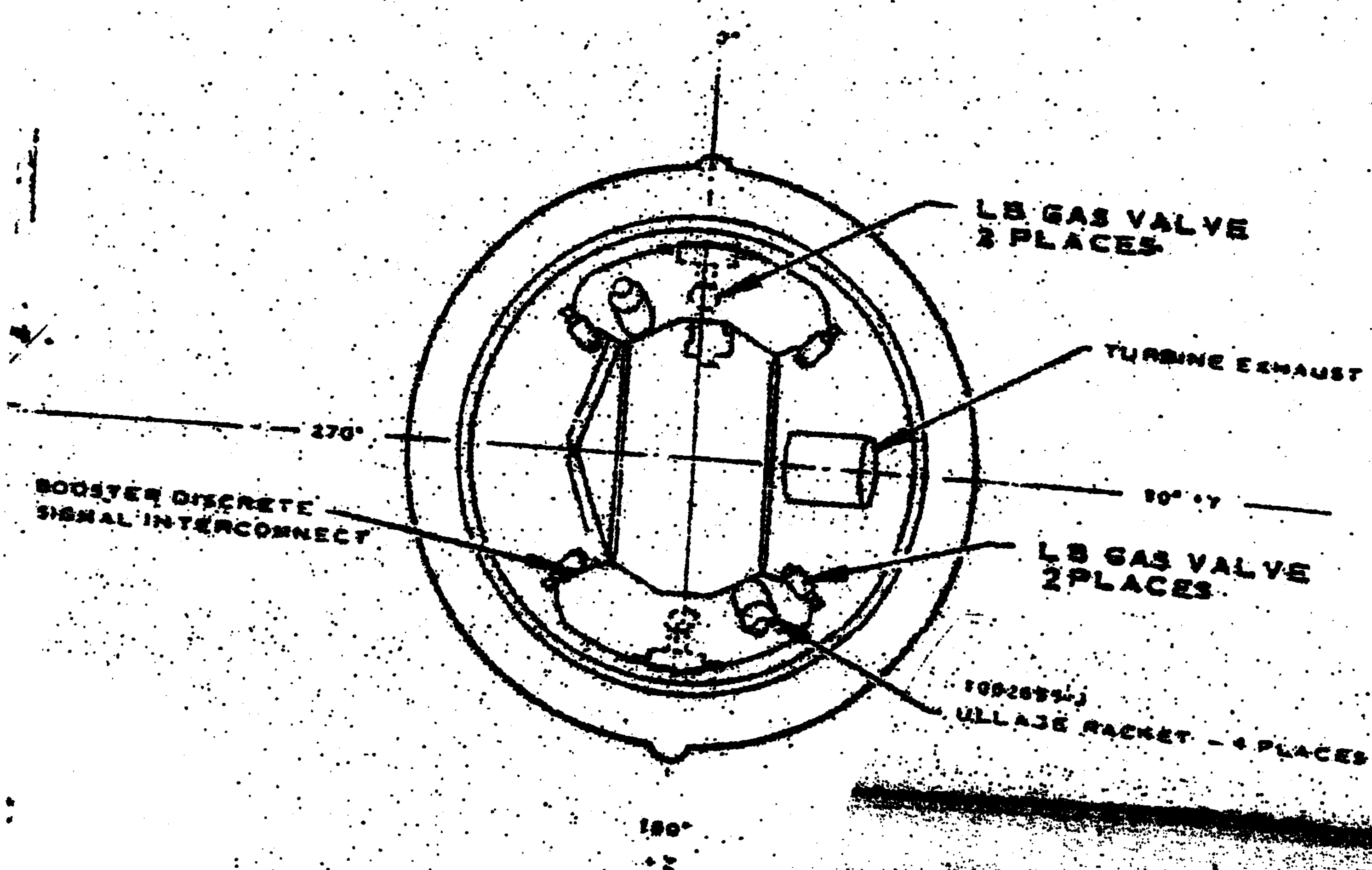

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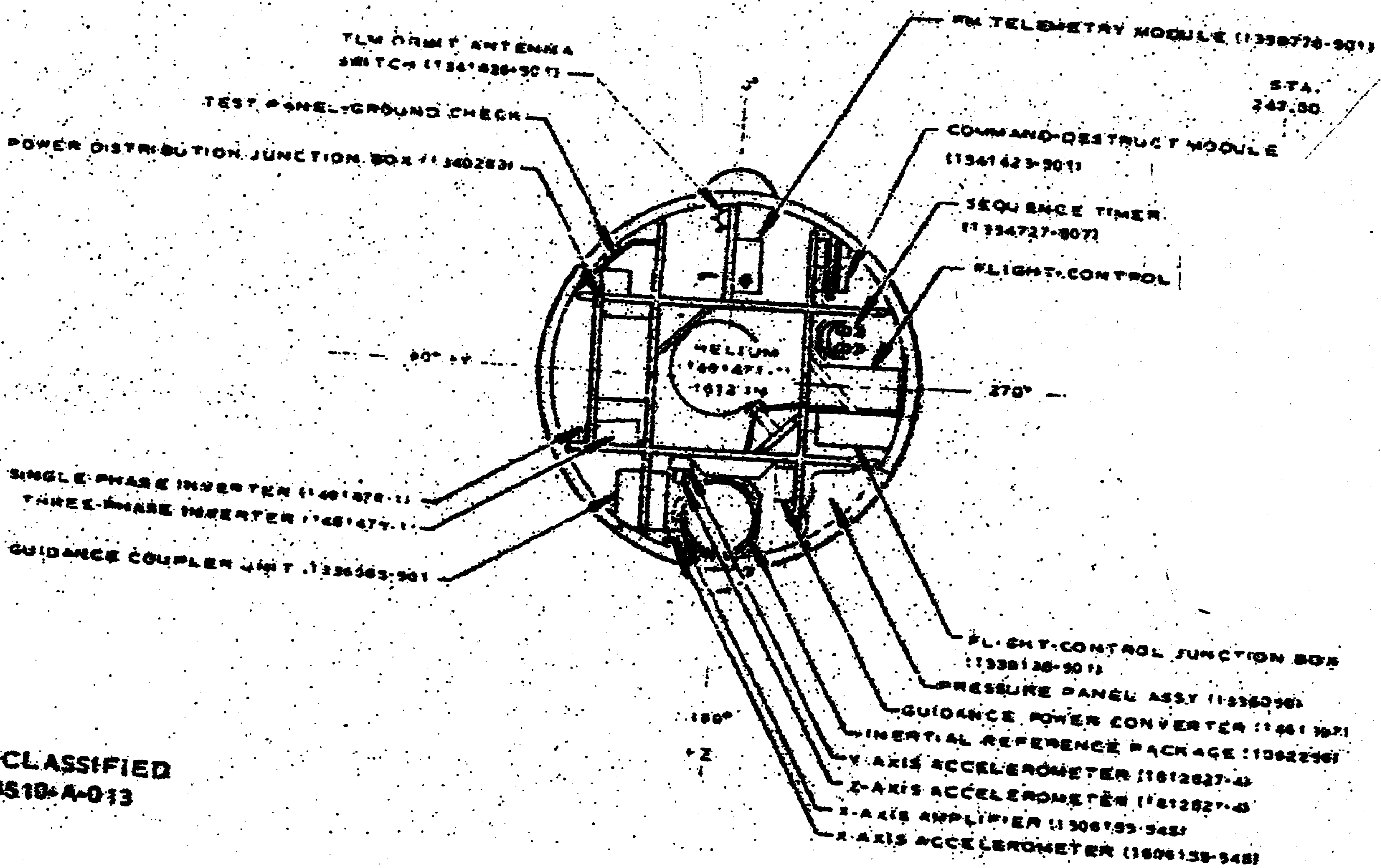

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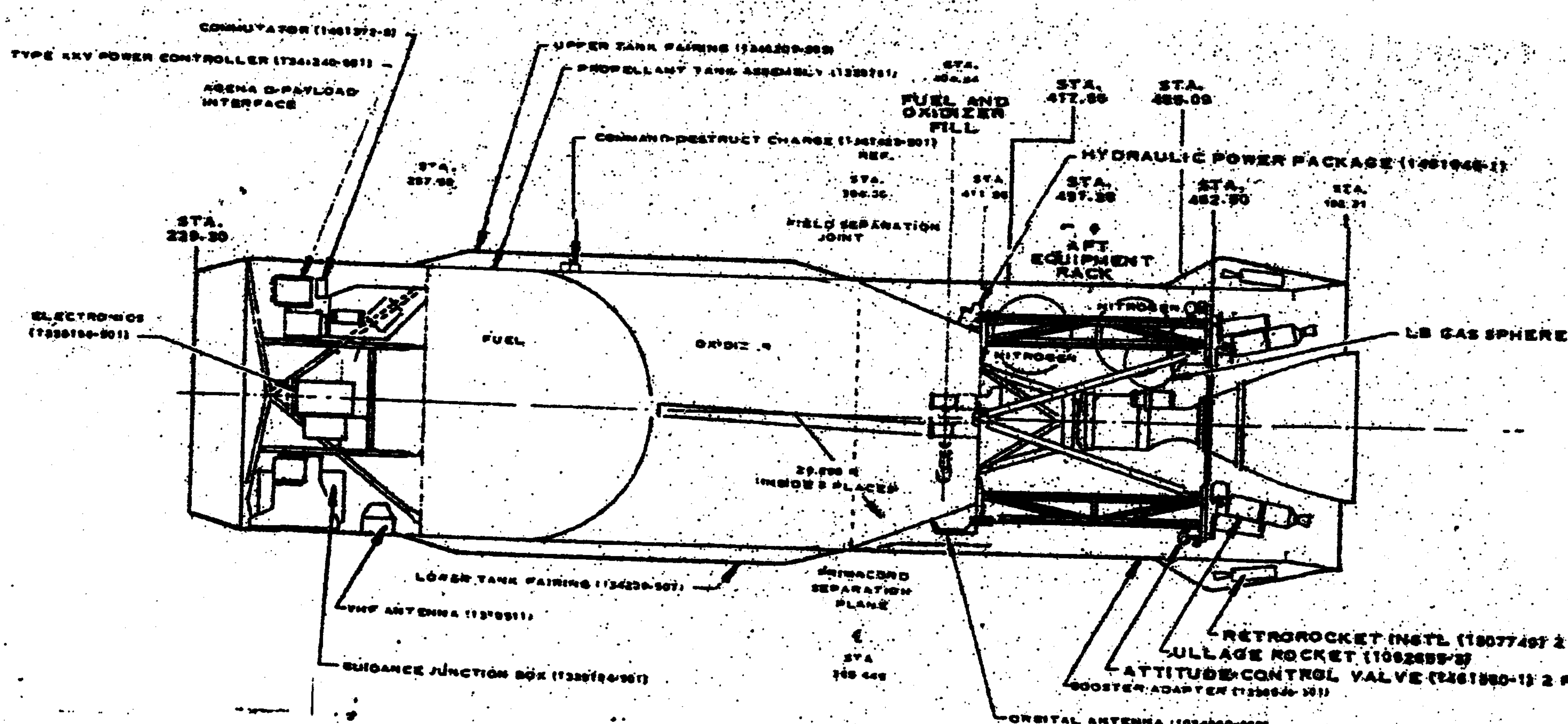
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PROPELLANT TANK ASSEMBLY
FUEL AND OXIDIZER FILL
STA. 477.86
STA. 485.09
COMMAND-DESTRUCT CHARGE
HYDRAULIC POWER PACKAGE
STA. 497.28
STA. 239.30
FIELD SEPARATION JOINT
AFT EQUIPMENT RACK
ELECTRONICS
NITROGEN
FUEL
LB GAS SPHERE
LOWER TANK FAIRING
PRIMACORD SEPARATION PLANE
VHF ANTENNA
RETROROCKET INSTL
ULLAGE ROCKET
ATTITUDE CONTROL VALVE
GUIDANCE JUNCTION BOX
BOOSTER ADAPTER
ORBITAL ANTENNA

4.1.4 Ground Communication System

The ground communication system consists of teletype, voice conference line and direct (hot) line systems, plus high frequency radio and microwave systems for off-base communications. Operational intercom, administrative dial and public announcing systems are provided for local communications.

4.2 DETAILED VEHICLE CONFIGURATION

The following subparagraphs contain a brief description of booster and satellite vehicle components.

4.2.1 Booster Configuration

The design of the booster has been adapted from the DM-21 (PG-2A) space vehicle. Design criteria of the SLV-2A booster are outlined in "Production and Acceptance Specification DS-2340" dated 31 August 1962. The top drawing number is 1A36317.

4.2.1.1 Airframe

The general arrangement of the SLV-2A booster is a central airframe with three solid-propellant rocket motors attached externally to the aft end. The airframe consists of a cylindrical two-tank structure with a base diameter of 8 feet; and a forward conical section, the diameter of which tapers from 8 to 5.33 feet. The lox tank vent includes an elbow assembly to direct gas diffusion after MECO, and to prevent chilling of the solid motors when the tank is vented in the terminal countdown. The engine section of the SLV-2A booster has thicker skin than SLV-2 which will be used for designated Program 162 vehicles. The ejection tracks for the solid motors have been added. Additional thrust ribs strengthen the skirt between the lox tank and the engine section. Cork insulation has been added to the surface of the base of the engine section and to the ejection tracks.

4.2.1.2 Propulsion System

The propulsion system consists of a gimballed Rocketdyne YLR -79-13 baffled main engine, two Rocketdyne LR-101-11 liquid-propellant vernier engines, and three solid propellant Thiokol TX33-52 rocket motors. The liquid propellant system is designated MB-3, Block III. The main engine is rated at 170,000 pounds thrust (± 3 per cent) at sea level; each vernier engine at 1,040 pounds of thrust (± 3 per cent) at sea level; and each solid propellant motor at 52,600 pounds of thrust (± 10 per cent) at sea level. The propulsion system also includes two main propellant tanks, a gas generator, a turbopump, propellant lines and associated plumbing. Propellants for the main and vernier engines are liquid oxygen (lox) and RJ-1 fuel (a kerosene-like hydrocarbon). The solid propellant for the TX33-52 motors is polybutadiene acrylic acid co-polymer (PBAA) as the fuel, 4.2.1.2 Propulsion Sy[redacted]

and ammonium perchlorate with 14 per cent aluminum as the oxidizer. The main engine gimbals to provide pitch and yaw attitude control; the vernier engines provide roll stabilization. The solid motors do not gimbal.

4.2.1.3 Solid Motors

Each solid motor of the SLV-2A booster is 31 inches in diameter and 237 inches in length. The total weight of each solid motor is approximately 8,796 pounds, of which 7,313 pounds are propellant. The case is of 4130 steel with internal insulation. The forward dome is hemispherical, with an opening for the pyregen igniter. The igniter is actuated by signal from the fuel injecter pressure switches on the main engine. When fuel injector pressure reaches the required level, a relay actutes igniters in the pyrogen unit, and flame is expelled into the bore of the solid moter, igniting the tips of the webbing. With propellant at 60 degrees Fahrenheit, the nominal burning duration is 27.8 seconds through the web. The total burning duration is 41.1 seconds at that temperature. At 60 deg F, initial thrust is predicted as 52,600 pounds; average thrust throughout the burning is 39,600 pounds.

4.2.1.4 Solid Motor Nose Cone

Each solid motor is fitted with an aluminum nose cone, which tapers from 31 inches to 0 over a length of 61 inches.

4.2.1.5 Solid Motor Suspension and Release

A thrust ball extends from the upper end of the solid motor case to transmit thrust to the vehicle. The ball fits into a socket on the booster at the transition between the lox tank and the engine section. Flanges on the ball and socket are clamped together in a retaining ring, which is tightened with an explosive bolt. Sway braces next to the ball restrict lateral movement of the solid motor. An ejection link between the solid motor and the booster base will direct the motor away from the booster when it is ejected. The bottom of the solid motor includes an ejection beam, which fits with an ejection rail at the bottom of the engine section. The rail is angled to slide the solid motor away from the booster after ejection.

4.2.1.6 Control System

The booster autopilot system is designed to stabilize and control the booster during powered flight. The major components of the system are the flight controller, the rate gyros, the hydraulic actuators, and the electrical power equipment.

4.2.1.7 Guidance System

BTL Series 400 Missile Borne Guidance Equipment decodes the steering and discrete commands transmitted by BTL Ground Guidance Station and routes them to the booster or satellite vehicle as required.

4.2.1.7 Electrical Equipment

In addition to the flight contr[redacted]RT-45 rate gyros, electrical equipment includes: A Bendix in[redacted]c, three phase, 400 cps, 1.5 kilovolt-amperes), one Yardney 2[redacted]lt battery for booster control power, one instrumentation battery for each[redacted] and associated wiring. The

4.2.1.7 Electrical Equipment (Cont'd)

inverter supplies ac power to the flight controller. The missile control battery is the primary power for the engine relay box circuits, the flight controller, the rate gyros, and the inverter.

4.2.1.8 Hydro-Mechanical Equipment

Hydro-mechanical equipment provides the motive power for gimbaling the engines in response to commands from the flight controller. During pre-flight checkout and launch, a ground system brings hydraulic pressures up to in-flight levels, and allows checkout of the control system. In flight, hydraulic pressures are maintained by a pump powered by the gas generator.

4.2.1.9 In Flight Hydraulics

The hydraulic pump and the hydraulic accessory unit, which includes a reservoir and accumulator system, maintain the in-flight hydraulic supply at a pressure of 3,000 psia for the demands of the engine actuators. Control equipment includes two main hydraulic actuator assemblies, two vernier pitch/roll actuator assemblies and two vernier yaw actuator assemblies. The major components of the actuators are the servo valve, the cylinder assembly, and the position feedback potentiometer.

4.2.2 Satellite Vehicle Configuration

The satellite vehicle consists of a basic S-01 or S-01A vehicle into which a Program 162 payload and special Geophysics Research Directorate (GRD) equipments are installed. The satellite vehicle is composed of the following subsystems: Subsystem A the spaceframe, Subsystem B the propulsion system, Subsystem C the electrical power system, Subsystem D the guidance and control systems and Subsystem H the airborne ground/space communications system. The payload is carried in the forward end of the satellite vehicle and covered by the nose cone. These components are briefly described in the following subparagraphs. A more thorough description of the S-01A vehicle is set forth in the Vehicle Familiarization Manual, LMSC A075695. The applicable equipment list sets forth vehicle components.

4.2.2.1 Subsystem A - Spaceframe

The satellite spaceframe, Subsystem A, consists of a nose section which houses the payload and is jetisoned for orbit, a forward body containing equipment racks, midbody consisting of propellant tanks and aft body with more equipment racks and the booster adapter which covers aft vehicle components and attaches to the booster. The spaceframe provides the aerodynamic shape for the satellite.

4.2.2.2 Subsystem B - Propulsion

The propulsion system consists of a Bell Aircraft liquid rocket engine, propellant feed and pressurization systems. It develops about 16,000 lbs thrust. The propulsion system uses UDMH for fuel and IRFNA for oxidizer.

4.2.2.3 Subsystem C - Internal Electrical Power

This subsystem supplies electrical power needed to operate satellite equipment. It consists of primary batteries; a three phase, 400 cycle, 115 volt inverter; a single phase, 400 cycle, 115 volt inverter; regulators, circuitry and associated equipment.

4.2.2.4 Subsystem D - Guidance and Control

Subsystem D directs the flight along a prescribed path in a controlled attitude according to a timed program by means of engine gimbaling and guidance gas jets. SS/D consists of a computer, an internal reference package, horizon sensors, flight control electronics package, pneumatic control system, hydraulic control system and secondary junction box.

4.2.2.5 Subsystem H - Ground Space Communications

This subsystem consists of RF receivers, transmitters and associated components. It transmits satellite status telemetry to the ground station and receives command signals from ground stations and sends verifications in response to accepted signals.

4.2.2.6 Subsystem J - Geophysics Research Directorate Equipment

This subsystem consists of instrumentation for conducting experiments and obtaining telemetered outer space data of interest to the Directorate.

4.3 DETAILED LAUNCH COMPLEX CONFIGURATION

The two launch complexes used for Program 162, 75-1 and 75-3, each have a Control Center Building connected to the launch pads by long run cables. Each of the four pads, 1 and 2 for Complex 75-1 and 4 and 5 for 75-3, is equipped with mechanical and electrical support equipment for vehicle servicing and checkout.

4.3.1 DAC Support Equipment

The configuration of DAC tactical support equipment has been modified to accommodate satellite vehicle launches. The equipment retains the capability of automatic checkout and launch preparation which are part of tactical system design. The components are briefly described in the following paragraphs.

4.3.1.1 Erecting - Launching Mount

The erecting-launching mount provides both the means of erecting the vehicle and the base from which it can be fired. The mount itself is supplemented by a hydraulic pumping unit and an erector-transporter boom. The mount is an adjustable, steel, support structure which is bolted to a prepared steel and concrete sub-structure. It serves as a pedestal for the vehicle and as a support for the service cables and ducts to the vehicle.