C E N T A U R

I

* What is Centaur?

The Centaur is a two stage missile. The first stage is an Atlas Inter Continental Ballistic Missile with three engines (two booster and one sustainer) producing a total of approximately 360,000 pounds of thrust. The Atlas engines use Liquid Oxygen and Kerosene as fuel. The second stage is a Centaur Tank with two engines producing a total of approximately 30,000 pounds of thrust. The Centaur engines use Liquid Oxygen and Liquid Hydrogen as fuel, and when fully developed, will have the capability of engine shutdown and restart in space. Prime Contractors for the Centaur Vehicle are: Atlas Booster and Centaur Tank - General Dynamics/Astronautics; Centaur Engines - Pratt & Whitney Aircraft; Guidance System - Minneapolis Honeywell.

* How did Centaur originate?

The Centaur Project originated in 1958 with the Advanced Research Projects Agency (ARPA). Technical control was assigned to the Air Force Research and Development Command (ARDC) with an authorization to develop and flight test a total of six Atlas/Centaur launch vehicles. As a result, in the fall of 1958, ARDC contracted with Pratt & Whitney Division of United Aircraft Corporation for the development of a high impulse, liquid hydrogen/ liquid oxygen engine to be used in the Centaur stage. General Dynamics/ Astronautics (then Convair Astronautics) was assigned the task to make modifications on the Atlas first stage booster, and design and develop the second stage Centaur. The Pratt & Whitney engines, for the second stage, are supplied to General Dynamics as Government Furnished Equipment.

On July 1, 1959, the responsibility for development of the Centaur was transferred from ARPA to NASA, and on July 1, 1960, the project was assigned to Marshall Space Flight Center. Shortly thereafter, on July 8, 1960, an additional four vehicles were added to the Project.

After the first launch on May 8, 1962, an extensive evaluation was made of the entire program by both NASA and the various contractors. Subsequent to this review, the management of the Centaur Project was transferred to Lewis Research Center on October 8, 1962.

Since the transfer of project managership, a basic reformation and consolidation of vehicle development and contracts has been accomplished. The program has been reduced to eight R&D vehicles including the first flight in 1962. A separate contract has been set up for engineering analysis and study problems related to the needs of the development program.

I

* What is the Centaur Mission?

The prime mission for Centaur at this time is Surveyor Lander, a Spacecraft designed for a soft lunar landing and subsequent transmission of data from the moon's surface and sub-surface. Surveyor Lander is an instrument-packed vehicle designed to take pictures of the moon's surface, sample soil, test for moon quakes, measure gravity and gather data on radiation, atmosphere and magnetism. The Surveyor program directly supports NASA's Manned Lunar Landing Program.

Planetary flights to Venus and Mars are also planned to utilize Centaur launch vehicles and Mariner "B" Spacecraft. These flights will carry ultra violet spectrometers, radiometers, radiation counters, plasma detectors, micrometeorite impact counters and other experiments. Mariner "B" is an essential part of our Lunar and Planetary exploration program.

Centaur is the United States' first sizeable true space vehicle. It is termed a "true space vehicle" because its engines can be started, shutdown and restarted to accomplish changes of direction and velocity in space. Centaur also is the first U. S. vehicle using liquid hydrogen as a fuel. Liquid hydrogen is superior to previous or conventional rocket propellants because of its high energy yield compared to fuel weight.

To support these and other important unmanned spacecraft flights, it is necessary to complete the principle development of the Centaur second stage vehicle by late 1964. Further development will continue to achieve reliable coast phase flight and gain increased performance margins.

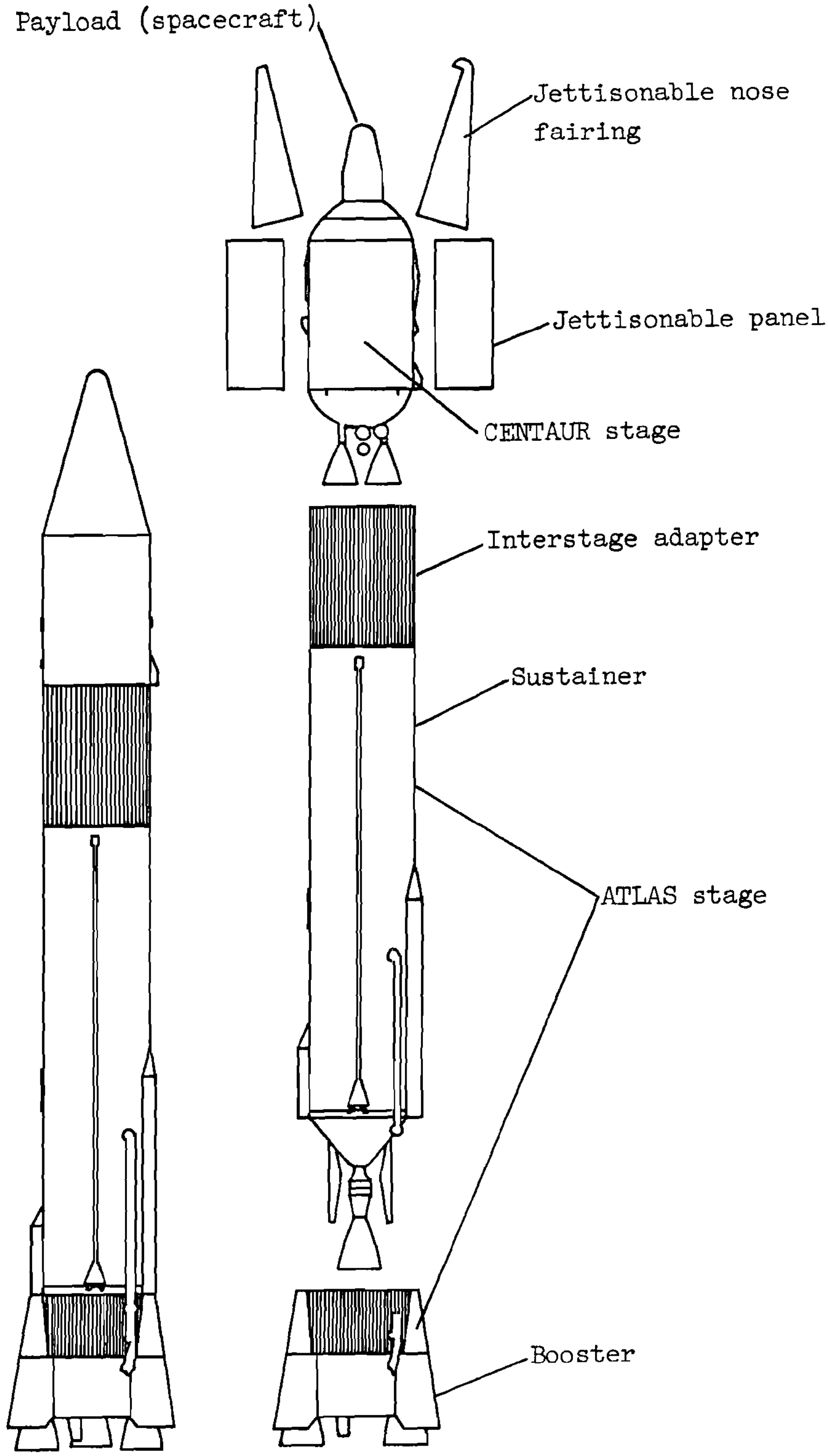

Exhibit III-1. - ATLAS/CENTAUR vehicle arrangement.

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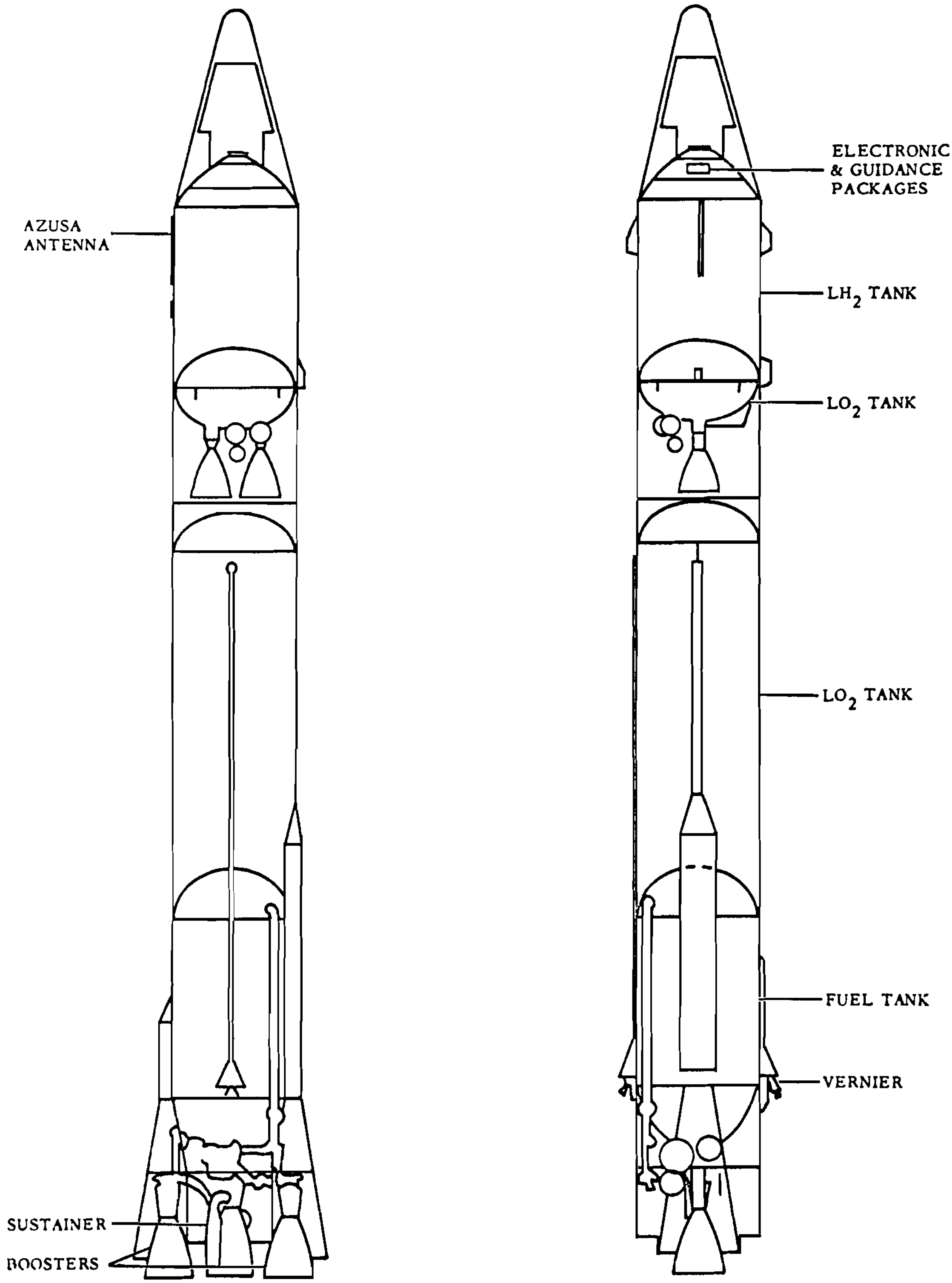


Exhibit III-2. - Over-all view of ATLAS/CENTAUR.

* What is the Centaur Project Office, how is it divided, and what are its prime responsibilities?

Heading the Centaur Project Office is Mr. Dave Gabriel, Project Manager. Under Mr. Gabriel there are three assistant managers: Mr. Cary Nettles, Mr. Ed Jonash and Mr. Ron Rovenger. Mr. Rovenger heads the Field Office at GD/A in San Diego.

The Business Administration Branch is headed by Mr. Robert Lambird.

The Business Administration Branch is assigned the responsibility for such program management functions as:

Developing and maintaining master schedules
Formulating financial operating plans and Program Development Plans
Preparation and control of quasi-contractual and financial actions

The Business Administration Branch is interested in all In House and Contractor operations which affect costs and schedules. This, of course, becomes quite inclusive. This office must monitor Contractor schedules and reports to determine their effects on costs and schedules. On a large project such as Centaur, this can indeed be a difficult assignment, and for this reason, we employ PERT and Companion Cost. Properly implemented, maintained and monitored, such techniques are invaluable.

On the financial side, we maintain our own budgeting and accounting system. First, adequate funds must be provided to do the job, and then these funds must be accounted for. The office must keep current on the funds committed and obligated to date, and what funds are available at any given point in time. Particularly, near the end of the fiscal year, this is of prime importance.

Instrumentation and Electrical Branch

The Instrumentation and Electrical Systems Branch is headed by Mr. John Quitter. This branch has the responsibility for surveying and monitoring all on-board electrical and electronic systems and subsystems with one exception, the guidance and control functions.

Some of the items under their jurisdiction are: instrumentation and telemetry systems, navigation and tracking systems, radar and azusa beacons, range safety system and electrical power storage, conversion and distribution systems. The electrical portion of ground support equipment is also monitored by this branch.

In order to properly discharge their responsibilities, the branch must review, study, evaluate and make recommendations regarding reports, proposals specifications, tests and test plans, and contracts which involve those subjects mentioned.

The branch, of course, must keep current with the state of the ART. Management is kept apprised of those advances which embody sound engineering design principles, and recommendations are made.

Structures and Materials Branch

Mr. Rene Chambellan is the acting chief of the Structures and Materials Branch.

The responsibilities of this branch are as follows:

> Establish the structural design criteria for static, vibration shock and other dynamic load environments.
>
> Insure that design and hardware meet the requirements for physical strength and insure that designs can be readily fabricated and reproduced.

The branch must keep informed in regards to materials available and fabrication techniques.

The branch reviews and evaluates all materials specifications, process specifications, and inspection and repair procedures. They review all stress, structural design and structural dynamics calculations and reports.

The branch reviews the results of material tests and evaluates them as they may apply to Centaur. They also analyze structural and mechanical failures during development and testing. Manufacturing defects are analyzed to determine if repair is possible or if an engineering investigation is required.

Finally, this branch also acts as a consultant in such areas as ground support equipment, test stands, etc.

Test Engineering Branch

This branch, headed by Mr. Russ Dunbar, is divided into two sections, the AWT (Altitude Wind Tunnel) Section and "E" Stand Section headed by Mr. Schmiedlin and Mr. Gerus respectively. These two sections are responsible for the LeRC tests of the Atlas/Centaur.

The AWT Section is responsible for carrying out the space environmental testing of the Centaur Vehicle and vehicle systems. Of particular interest are propellant dynamics and thermodynamics and zero gravity problems. Test programs to study these subjects are developed by this section, and tests are run and results analyzed. The findings are then used by Centaur in future planning.

At the Plumbrook "E" Stand, the Atlas/Centaur is tested to determine dynamic and vibrational characteristics.

Between these two sections is divided the responsibility of learning all about Atlas/Centaur that can possibly be learned on the ground. This is in support of the basic philosophy that we will not test in space anything which can be tested on the ground.

Guidance and Control Branch

Mr. Herman Hamby heads the Guidance and Control Branch. This branch is responsible for the adequacy of the guidance system design relative to the requirements of the flight mission profiles. To properly execute this responsibility, they must establish guidance theories for assigned projects, including guidance equations and selection of parameters with regard to guidance terms used. They must conduct basic studies in the field of guidance, survey new developments, proposals and theories and analyze error sources of existing system to establish new guidance schemes and improve existing ones.

This branch must maintain an awareness of current hardware systems, schemes, philosophies, etc. They must establish trajectories for all test firings of flight vehicles, with or without guidance. They furnish preliminary and final trajectories for all test firings of flight vehicles, with or without guidance. They furnish preliminary and final trajectory data and flight mechanical and aerodynamic characteristics required for flight trajectories.

Contractor Facilities and Mechanical GSE Branch

Mr. Elmo Farmer heads the Contractor Facilities and Mechanical GSE Branch. This branch is responsible for the construction and modification of all facilities for the Centaur Program, except those located at LeRC.

Under this heading come the modifications to the launch facilities at the Atlantic Missile Range. There is also a new launch facility planned and under their jurisdiction. They are responsible for the many modifications to the various test facilities throughout the country.

Mr. Farmer's group is not only responsible for what is commonly referred to as the "brick and mortar" but will also monitor the Ground Support Equipment required for the Centaur Program. Included here are the propellant loading and handling systems at various test sites and at Atlantic Missile Range. Last, but not least, are the gas systems required for pressurizing and purging.

Launch Operations Branch

The Launch Operations Branch is headed by Mr. Dick Yeager. Dick is the coordinator and liaison for LeRC for each vehicle launch. His branch is responsible for monitoring vehicle factory checkout and acceptance tests. After the vehicle sell off, they participate in the preparation of the vehicle pre-launch checkout and test at Atlantic Missile Range.

They initiate Ground Support Equipment design changes precipitated by vehicle design changes.

They prepare the official range documentation such as program requirements, program support plan, individual flight operations requirements, initiate and coordinate data acquisition and reduction requirements, initiate the flight data analysis for each launch and prepare reports thereof.

Propulsion and Feed Systems Branch

Ed Jonash, an Assistant Manager, is acting head of the Propulsion and Feed Systems Branch. This branch is divided into two section, the Propellant Section headed by Dr. Brun, and the Propulsion System Section headed by Bill Goette.

As the titles imply, the Propellant Section is responsible for the Propellant System. This includes the study of such areas as propellant dynamics, propellant thermodynamics, heat transfer problems on all vehicle systems, and zero gravity tests. As you are aware, Centaur uses liquid oxygen and hydrogen propellants. The temperature at which these fuels exist as a liquid are extremely low, and the field of cryogenics is fairly new. It is Dr. Brun's section that studies the handling of these propellants and the problems inherent with their handling.

The Propulsion Section evaluates changes proposed to the Pratt & Whitney A-3 engines to assure engine vehicle compatibility. They monitor production engine performance, reliability and delivery schedules and propose, monitor and evaluate advanced development programs and testing of the engines.

Systems Integration and Performance Branch

Mr. Carl Wentworth heads the Systems Integration Branch. This branch has the responsibility for providing information with respect to the whole Atlas/Centaur vehicle. They fulfill a need for correlation between all the interacting subsystems and between areas separated by organizational divisions.

This branch reviews the over-all system design for compatibility of all subsystems, reviews matters pertaining to the Centaur payload interface and the Atlas/Centaur interface, and resolves conflicts which may arise.

Contracts

Mr. Len Perry heads our Contracts or Procurement Branch. This group is responsible for all procurement actions required to support the Centaur Project Office. They review and coordinate purchase requests, statements of work, develop sources, determine best methods of procurement, coordinate technical proposals and develop proper procedure for pricing. It is their responsibility to select the most appropriate contract type, to negotiate and to make awards.

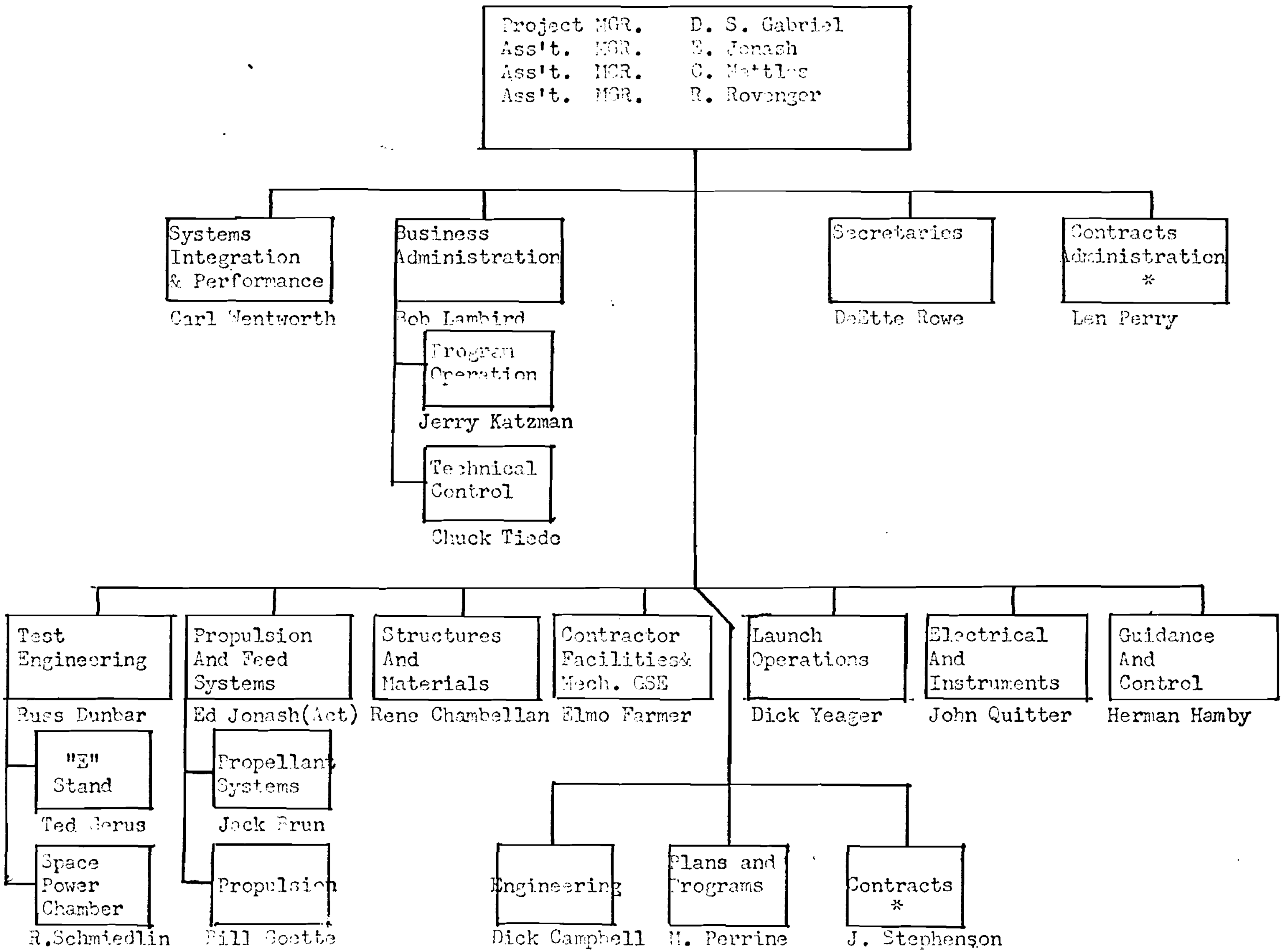
In addition, this branch prepares changes and amendments to the contract as required, and conducts termination and contract close-out actions where advisable.

Field Office, General Dynamics/Astronautics

Mr. Ron Rovenger heads our San Diego Field Office. In a sense, this office duplicates on a small scale the Cleveland Project Office. Their staff includes engineers, procurement people and a Plans and Programs Office.

Their function is to work closely with the prime contractor on the project and to handle routine problems which arise. In addition, on more complex problems, this group provides valuable assistance to the Cleveland staff because of their intimate relationship with the Contractor.

CENTAUR PROJECT OFFICE



* = Supporting Org

June 1963

Quasi - Official
Centaur Organization Chart

* What offices at LeRC is the Centaur Project Office directly concerned?

1. DEVELOPMENT DIRECTORATE

   a. <u>Office of Development Plans and Programs</u>

      PROGRAM SCHEDULES

      P/R CONTROL

   b. <u>Reliability and Quality Assurance</u>

      QUALITY CONTROL

      RELIABILITY

   c. <u>AGENA PROJECT</u>

      ATLAS TECHNICAL MONITORING

   d. <u>CHEMICAL ROCKET SYSTEMS DIVISION</u>

      RL/10 ENGINE TESTS

2. RESEARCH DIRECTORATE

   a. <u>INSTRUMENTS & COMPUTING DIVISION</u>

      BUDGET RUNS ON 1401 COMPUTER

      PERT REPORTS ON IBM TRANSCEIVER

   b. <u>MATERIALS & STRUCTURES DIVISION</u>

3. TECHNICAL SERVICES

   a. <u>PERT OFFICE</u>

   b. <u>SERVICE SCHEDULING</u>

   c. <u>FACILITIES ENGINEERING DIVISION</u>

      SPACE POWER CHAMBER

      "E" STAND

4. BUDGET OFFICE

   CERTIFICATION OF FUNDS (PR) SUBALLOTMENTS

5. PLUM BROOK (SANDUSKY, OHIO)

   "E" STAND

6. ADMINISTRATION DIRECTORATE

   a. ADMINISTRATIVE SERVICES - PHONE, FAXWRITER, ETC.

   b. PROCUREMENT & SUPPLY DIVISION

      CENTAUR PROCUREMENT SECTION

      RESEARCH PROCUREMENT

      CONSTRUCTION & SERVICES

      FABRICATION (IN HOUSE)

   c. FINANCE DIVISION

      ACCOUNTING & AUDIT

IV

* How does the Centaur fit into the overall American Space Effort?

See attachments. Those items underlined are wholly or in some part dependent upon Centaur and/or Centaur developed technology.

U. S. Space Vehicles

VEHICLE	STAGES I	II	III	IV	V	Payload Capacity (pounds in orbit)	TYPICAL APPLICATIONS
Scout	Algol-solid fuel 103,000 pounds thrust	Castor-solid fuel 62,000 pounds thrust	Antares, solid fuel 13,600 pounds thrust	Altair, solid fuel 2800 pounds thrust		150	Scientific satellite
Delta	Thor-Lox, Kerosene fuel 150,000 pounds thrust	Delta-nitric acid & Hydrazine fuel 7700 pounds thrust	Altair			500	Scientific, communication satellites
Thor-Agena B	Thor	Agena B-Nitric				1,600	Scientific, military weather satellites
Atlas-Agena B	Atlas booster, two Lox-Kerosene engines, total thrust 300,000 pounds	Atlas sustainer, one Lox-Kerosene engine, 60,000 pounds thrust	Agena B			5,000	Scientific, military, satellites, deep space probes
Centaur*	Atlas booster	Atlas sustainer	Centaur, two Lox-Liquid hydrogen engines, total thrust 30,000 pounds			8,500	Scientific, weather, communication satellites deep space probes

U. S. Space Vehicles

VEHICLE	STAGES I	II	III	IV	V	Payload Capacity (pounds in orbit)	TYPICAL APPLICATIONS
Saturn C-1	S-I, eight H-1 Lox-Kerosene engines, total thrust 1,500,000 pounds.	S-IV, Six Centaur engines, total thrust 90,000 pounds	(For some applications) S-V Modified Centaur			20,000	Apollo earth orbit missions, Dyna-soar, deep space probes
Saturn C-2	S-1	S-II, Four J-2 Lox-liquid hydrogen engines, total thrust 800,000 pounds.	S-IV	S-V for some * missions		45,000	Operational manned military spacecraft, deep space probes
Saturn C-3 (Liquid)	S-IB, Two F-1 Lox-Kerosene engines, total thrust 3,000,000 pounds	S-II (With longer tankage than on Saturn C-2).	S-IV	S-V for some missions		80,000	Apollo circumlunar flights
Saturn C-3 (Solid)	Cluster of solid engines, total thrust 5,000,000 pounds.	Same as liquid	Same as liquid	Same as liquid		80,000	Apollo Circumlunar flights
Saturn C-4 (Also called Nova 4) (Liquid)	Four F-1 engines, total thrust 6,000,000 pounds.	S-II (with longer tankage than on Saturn C-3)	S-IV-B, one J-2 engine, thrust 200,000 pounds	S-V for some missions		160,000	Apollo circumlunar flights, rendezvous two payloads for lunar landing

U. S. Space Vehicles

VEHICLE	STAGES I	II	III	IV	V	Payload Capacity (pounds in orbit)	TYPICAL APPLICATIONS
Advanced Saturn (Saturn C-5) (Liquid)	S-1 B, Five F-1 engines, total thrust 7,500,000 pounds	S-II Five J-2 engines, total thrust 1,000,000 pounds	S-IV B	S-V for some missions		200,000	Apollo circumlunar flights, rendezvous two payloads for lunar landing
Advanced Saturn (Nuclear)	S-I B	S-II	Nuclear Nerva (thrust classified)	Lunar landing stage	Lunar takeoff stage	350,000	Apollo lunar landing
Nova (Liquid)	N-I, Eight F-1 engines, total thrust 12,000,000 pounds	N-II, Four M-1 engines, total thrust 4,800,000 pounds	N-III, similar to S-IV B, one J-Z	Lunar landing stage	Lunar takeoff stage	350,000	Apollo lunar landing
Nova (Solid)	Cluster of solid engines, total thrust 20,000,000 pounds	Same as liquid	Same as liquid	Lunar landing stage	Lunar takeoff stage	350,000	Apollo lunar landing

U. S. Military Satellites

PROJECT & SPONSOR	DESCRIPTION	LAUNCH VEHICLE	ORBIT
Advent-Army	Instantaneous repeater Communication satellite	Centaur	24-hour equatorial
ANNA--Army, Navy, Air Force, NASA	Geodetic satellite		
ARENTS--ARPA	Test satellite	Centaur	24-hour inclined
Bambi-ARPA	Anti-ICBM satellite		
Discoverer--Air Force	System for tests of stabilization, re-entry and recovery techniques	Thor-Agena	Low Polar
Dyna-Soar--Air Force, NASA	Manned space glider to test controlled re-entry	Titan III	Low, inclined
Midas--Air Force	Warns of missile launchings by detecting infrared from rocket exhaust	Atlas-Agena	2000-mile
SAINT--Air Force	Inspects possibly hostile after achieving near-rendezvous	Atlas-Agena	Same as target
SAMOS--Air Force	Reconnaissance satellite	Atlas-Agena	Low polar
Transit--Navy	Navigation satellite	Thor-Able Star, Scout later	Low inclined

U. S. Scientific Satellite and Deep-Space Probe Projects

PROJECT	TRAJECTORY	MISSION	LAUNCH VEHICLE
Explorer	Earth orbits	Various scientific measurements	Various
Ranger	Earth-moon	Rough landing of survivable instruments	Atlas-Agena B
Mariner	To Venus and Mars vicinity	Measurements in interplanetary space and near planets	Atlas-Agena B (later Centaur)
Surveyor	Earth-moon	Soft landing of TV transmitters and instruments	Centaur
Orbiting Solar Observatory	Earth orbit, about 350 miles	Continuous watch on solar activity	Delta
Orbiting Geophysical Observatory	I-Polar earth orbit; II-Elliptical earth orbit	"Streetcar" satellite to carry many scientific experiments	I-Thor Agena B; II-Atlas-Agena B
Orbiting Astronomical Observatory	Earth orbit, 500 miles	Observe stars with large telescope and other instruments	Atlas-Agena B
Prospector	Earth-moon	Land large payload with roving vehicle, instruments and advance supplies for manned flight	Saturn
Voyager	Venus and Mars	Orbit planet and eject capsule for entry into planetary atmosphere	Saturn

U. S. Communication Satellites and Related Experiments (Continued)

PROJECT & SPONSOR	SPACECRAFT	LAUNCH VEHICLE	TRAJECTORY
Telstar (AT&T)	125-pound active repeater, sphere shape	Thor-Delta	Orbit, 600-3000 miles
SynCom (NASA)	50-pound active repeater	Thor-Delta plus small solid fourth stage	22,300-mile (24-hour) 33° inclined orbit
Relay (NASA)	100-pound active repeater, octagon shape	Thor-Delta	Orbit, 1000-3000 miles
ARENTS (ARPA)	Test Satellite	Centaur	22,300-mile (24-hour inclined orbit
Relay-Advanced (NASA)	Two or more Relays in one package	Atlas-Agena B	Orbit, 5000-6000 miles
Rebound (NASA)	Three Echo II balloons in one package	Atlas-Agena B	Orbit, 1500-2500 miles
Advent (Army)	Active Repeater	Centaur	22,300-mile (24-hour) equatorial orbit

U. S. Communication Satellites and Related Experiments

PROJECT & SPONSOR	SPACECRAFT *	LAUNCH VEHICLE	TRAJECTORY
SCORE (ARPA-Army)	Atlas plus 150 pounds communication equipment	Atlas	Orbit, 110-910 miles
Echo I (NASA)	Aluminum-coated plastic 100-foot balloon	Thor-Delta	Orbit, 945-1049 miles
Courier I-B (Army)	500-pound delayed repeater, with 300 pounds equipment	Thor-AbleStar	Orbit, 501-658 miles
Explorer XII (NASA)	83-pound radiation experiment package	Thor-Delta	Elliptical orbit
Echo II (NASA)	Rigidized aluminum-coated plastic 135-foot balloon	Thor	Suborbital to 700-800 miles altitude & 600 miles downrange
Echo II (NASA)	Same	Thor-Agena B	Orbit, 700 miles

U. S. Weather Satellites--Research and Development

PROJECT	WEIGHT (POUNDS)	INSTRUMENTATION	ORBIT	LAUNCH VEHICLE
Tiros I	270	Two TV cameras	400-mile circular, 50° inclination	Thor-Able
Tiros II-VI	280	Two TV cameras, infrared sensors	400-mile circular, 50° inclination	Delta
Nimbus	600	multiple TV cameras, infrared sensors	600-mile circular, 80° inclination	Thor-Agena
Advanced Nimbus	not set	TV cameras, infrared sensors, solar measurements, infrared spectrometer, radar	Not set	Not set
Aeros	600 or more	Zoomar camera, others not set	24-hour equatorial	Centaur

* What are some of the terms used in discussing the Centaur, and what do their abbreviations mean?

ABM	-	Advance Bill of Material
A/C	-	Air-conditioning
A/C/S	-	Atlas/Centaur/Spacecraft
AGE	-	Aerospace Ground Equipment
AGSE	-	Aerospace Ground Support Equipment
AMR	-	Atlantic Missile Range
ARDC	-	Air Research & Development Command (Air Force)
ARENTS	-	Advanced Research Environmental Test Satellites
ARPA	-	Advanced Research Projects Agency
AZUSA	-	A highly accurate Tracking System
BECO	-	Booster Engine Cut-Off
BPTV	-	Battleship Propulsion Test Vehicle
CSTP	-	Combined Systems Test Plan
CSTS	-	Combined Systems Test Stand
CVCT	-	Centaur Vertical Checkout Tower
DOC	-	Data, Operation and Control
DSIF	-	Deep Space Instrumentation Facility
ECP	-	Engineering Change Proposal
EID	-	End Item Description
EMI (EM)	-	Electro Mechanical Interference
ERS	-	Edwards Rocket Site
ESA	-	Explosive Safe Area
ETO	-	Ethylene Oxide
FOM	-	Figure of Merit
FPR	-	Flight Performance Reserve

GFE	-	Government Furnished Equipment
GHE	-	Ground Handling Equipment
GSE	-	Ground Support Equipment
GSFC	-	Goddard Space Flight Center
HAS	-	Hughes Aircraft Company
ISDS	-	Inadvertent Separation Destruct System
ISP	-	Specific Impulse
JPL	-	Jet Propulsion Laboratory
LeRC	-	Lewis Research Center
LH_2	-	Liquid Hydrogen
LOC	-	Launch Operations Center
LOX	-	Liquid Oxygen
MAST	-	Missile and Spacecraft Telemeter
MES	-	Main Engine Start
MFCO	-	Manual Fuel Cut-Off
MGS	-	Missile Guidance Set
MM	-	Match Mate
MOPS	-	Missile Operational Intercommunication System
MSFC	-	Marshall Space Flight Center
MSU	-	Mobile Sterilization Unit
MTCU	-	Mobile Temperature Control Unit
NPSH	-	Net Positive Suction Head
PDP	-	Project Development Plan
PIN	-	Proposal Identification Number
PLIS	-	Propellant Level Indicator System
PMR	-	Pacific Missile Range

V

PR	-	Purchase Request
PTV	-	Propulsion Test Vehicle
PU	-	Propellant Utilization
RCC	-	Rough Combustion Cut-Off
RFI	-	Radiation Frequency Interference
RSCS	-	Range Safety Command System
S/C	-	Spacecraft
SCLV	-	Standardized Centaur Launch Vehicle
SECO (SCO)	-	Sustainer Engine Cut-Off
SFOF	-	Space Flight Operational Facility
SLOT	-	Surveyor Launch Operation Trailer
SS	-	Sub System
STL	-	Space Technology Laboratories
TCP	-	Task Change Proposal
TLM	-	Telemeter
URFT	-	Ullage Rocket Firing Time
VECO (VCO)	-	Vernier Engine Cut-Off
WAG	-	Wild Guess
W/O	-	Without

VI

* Where and how does the Centaur Project Office fit into the Lewis Research Center?

  See attached LeRC organizational chart.

National Aeronautics and Space Administration
LEWIS RESEARCH CENTER
Cleveland, Ohio

APPROVED: Abe Silverstein
ABE SILVERSTEIN
DIRECTOR
DATE: FEBRUARY 21, 1963

- DIRECTOR Abe Silverstein / DEPUTY DIRECTOR E. J. Manganiello
  - BUDGET OFFICE V. Gordon
  - PLUM BROOK STATION A. D. Johnson
  - ASSOCIATE DIRECTOR FOR RESEARCH E. J. Manganiello / DEPUTY ASSOCIATE DIRECTOR FOR RESEARCH J. C. Evvard
    - OFFICE OF RESEARCH PLANS AND PROGRAMS J. F. Connors, Chief
    - CHEMISTRY AND ENERGY CONVERSION DIVISION N. D. Sanders, Chief
    - ELECTROMAGNATIC PROPULSION DIVISION W. E. Moeckel, Chief
    - MATERIALS AND STRUCTURES DIVISION S. S. Manson, Chief
    - INSTRUMENT AND COMPUTING DIVISION J. H. Hall, Chief
    - FLUID SYSTEM COMPONENTS DIVISION I. I. Pinkel, Chief
    - NUCLEAR REACTOR DIVISION L. V. Humble, Chief
  - ASSOCIATE DIRECTOR FOR DEVELOPMENT B. T. Lundin / DEPUTY ASSOCIATE DIRECTOR FOR DEVELOPMENT (Vacant)
    - OFFICE OF DEVELOPMENT PLANS AND PROGRAMS C. F. Schueller, Chief
    - OFFICE OF REALIBILITY AND QUALITY ASSURANCE R. R. Godman, Chief
    - SPACE POWER SYSTEMS DIVISION B. Lubarsky, Chief
    - CENTAUR PROJECT D. S. Gabriel, Manager
    - AGENA PROJECT S. C. Himmel, Manager
    - CHEMICAL ROCKET SYSTEMS DIVISION I. A. Johnsen, Chief
    - ADVANCED DEVELOPMENT AND EVALUATION DIVISION H. M. Henneberry, Chief
    - SPACECRAFT TECHNOLOGY DIVISION J. H. Childs, Chief
  - CHIEF OF TECHNICAL SERVICES O. W. Schey / ASSOCIATE CHIEF OF TECHNICAL SERVICES C. A. Herrmann
    - SERVICE SCHEDULING OFFICE R. A. Maurer
    - SAFETY OFFICE W. Maxim
    - CONSTRUCTION OFFICE R. H. Brown
    - PERT OFFICE J. D. Walker
    - PLANT SERVICES DIVISION J. C. Everett, Chief
    - TEST INSTALLATIONS DIVISION W. A. Egan, Chief
    - FACILITIES OPERATIONS DIVISION J. N. Vivien, Chief
    - FABRICATION DIVISION A. F. Reader, Chief
    - ENGINEERING DESIGN DIVISION W. J. McCann, Chief
    - FACILITIES ENGINEERING DIVISION B. G. Gulick, Chief
  - ASSISTANT DIRECTOR FOR ADMINISTRATION H. C. Barnett
    - MANAGEMENT ANALYSIS R. W. Schmidt
    - SECURITY R. W. Gaines
    - PATENT COUNSEL N. T. Musial
    - CHIEF COUNSEL S. N. Hosenball, Acting
    - PERSONNEL DIVISION G. Macian, Chief
    - FINANCE DIVISION L. F. Hinz, Chief
    - ADMINISTRATIVE SERVICES DIVISION R. W. Schmidt, Chief
    - PROCUREMENT AND SUPPLY DIVISION E. S. Hicks, Jr., Chief
    - TECHNICAL INFORMATION DIVISION J. J. Modarelli, Chief
  - ASSISTANT DIRECTOR FOR PUBLIC AFFAIRS W. T. Olson

N-283

VII

CENTAUR CRONOLOGICAL FACTS

1. 10-58 Basic Contract Let with Pratt and Whitney for Liquid Hydrogen/Liquid Oxygen, 15K Thrust Engine.
2. 11-58 Basic Contract Let with General Dynamics Astronautics for CENTAUR Upper Stage Vehicles.
3. 5-59 Contract Let with General Dynamics Astronautics for Guidance Equipment.
4. 6-59 Advanced Research Projects Agency Transfers Responsibility for CENTAUR to NASA.
5. 7-59 Contract Let for Construction of Complex 36 Blockhouse.
6. 9-59 Contract Let for Launch Pad and Service Building, Complex 36.
7. 6-60 NASA Headquarters assigns CENTAUR Project to Marshall Space Flight Center.
8. 8-60 First Guidance Set Delivered by Minneapolis-Honeywell to General Dynamics Astronautics.
9. 8-60 First Ground Test Engine Delivered by Pratt and Whitney to General Dynamics Astronautics.
10. 2-61 First Atlas Booster Delivered to Atlantic Missile Range.
11. 2-61 Atlas Booster Erected at Complex 36A, Atlantic Missile Range.
12. 3-61 First CENTAUR upperstage delivered to Atlantic Missile Range.
13. 3-61 CENTAUR upperstage mated to Atlas Booster, at Complex 36A, Atlantic Missile Range.
14. 10-61 CENTAUR upperstage returned to General Dynamics Astronautics to determine cause of Leak in Bulkhead.
15. 10-61 Second CENTAUR upperstage shipped to Atlantic Missile Range, and mated with first Atlas booster.
16. 4-62 First CENTAUR launch attempt scrubbed.
17. 4-62 Second CENTAUR launch attempt scrubbed.
18. 5-62 Third CENTAUR launch attempt successful, flight laster approximately 60 seconds, then blew up.
19. 10-62 CENTAUR Project transferred from Marshall Space Flight Center to Lewis Research Center.
20. 3-63 Second Atlas Booster/CENTAUR upperstage shipped to Atlantic Missile Range 36A and erected for tests.