SHUTTLE/CENTAUR PROJECT PERSPECTIVE

Edwin T. Muckley
National Aeronautics and Space Administration
Lewis Research Center

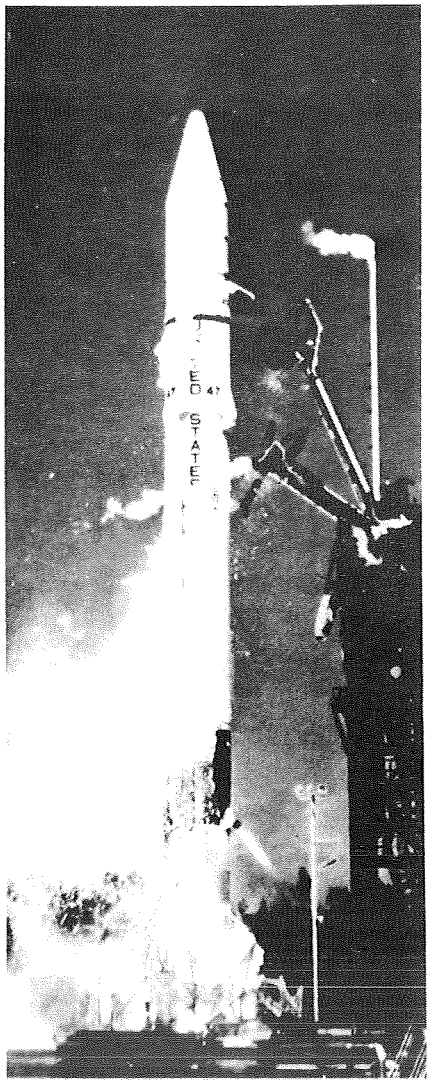
The Shuttle/Centaur vehicle is being developed as an expendable, cryogenic high energy upper stage for use with the National Space Transportation System (NSTS). The stage is expected to meet the demands of a wide range of users including, NASA, the DOD, private industry and the European Space Agency (ESA). The Shuttle/Centaur will be a modification of the highly successful Centaur stage, used extensively with the Atlas and Titan boosters since 1966 to launch planetary, geosynchronous and earth orbital missions for these aforementioned users. This paper describes the design changes required for use with the NSTS. These are primarily related to: 1) tank resizing to take advantage of the orbiter payload bay dimensions; 2) provisions for physically adopting Centaur to the orbiter; and, 3) accommodating safety requirements of the manned NSTS. The paper will also describe the expected performance capabilities of two versions of the Shuttle/Centaur. The initial version, designated G-prime, is the larger of the two, with a length of about 9.1m (30 ft.). This vehicle will be used to launch the Galileo and International Solar Polar Missions (ISPM) to Jupiter in May 1986. The Galileo to be launched for NASA's Jet Propulsion Laboratory, will orbit the planet, observe its satellites, and a probe portion will separate and descend into the Jovian atmosphere. The European Space Agency ISPM spacecraft will use Jupiter's mass to deflect its trajectory out of the ecliptic plane and gather data in the sun polar region.

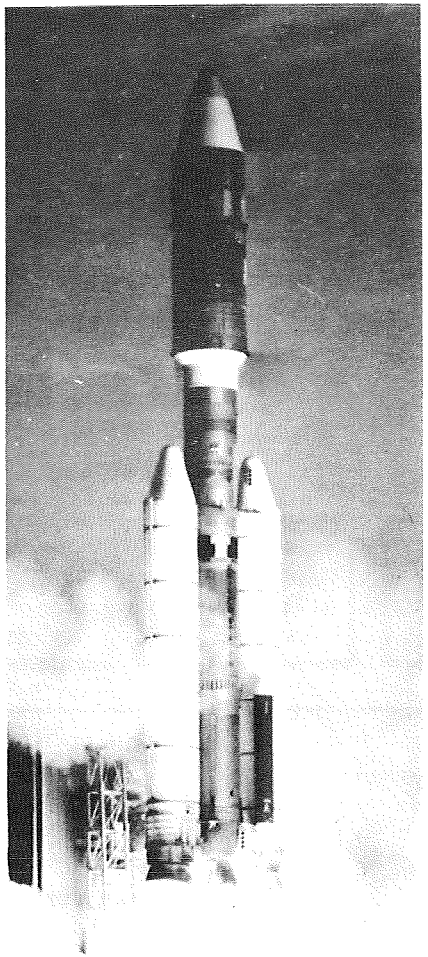
The second version of the Shuttle/Centaur designated the G vehicle, is about 3.0m (ten ft.) shorter than the G-prime. This shorter stage also takes advantage of the orbiter 4.6m (15 ft.) diameter, but maximizes the spacecraft length capability in the payload bay to about 12.2m (40 ft.). It is currently scheduled to launch payloads for the DOD, the NASA Venus Radar Mapper and TDRSS Missions in 1988, and is expected to provide launch services well into the 1990's.

CENTAUR IS A MATURE, FLIGHT PROVEN, HIGH-ENERGY UPPER STAGE

Atlas/Centaur

Payloads	**61**
Test Flight	8
Surveyor	7
ATS	2
OAO	3
Mariner Mars	4
Intelsat IV	8
Intelsat IVA	6
Pioneer F	1
Pioneer G	1
MVM	1
Comstar	4
HEAO A	1
HEAO B	1
HEAO C	1
Fltsatcom	5
Pioneer Venus	2
Intelsat V	6





Titan/Centaur

Payloads	**7**
Test Flight	
Helios A	
Helios B	
Viking A	
Viking B	
Voyager 1	
Voyager 2	

Figure 1

LEWIS RESEARCH CENTER/CENTAUR ORGANIZATION

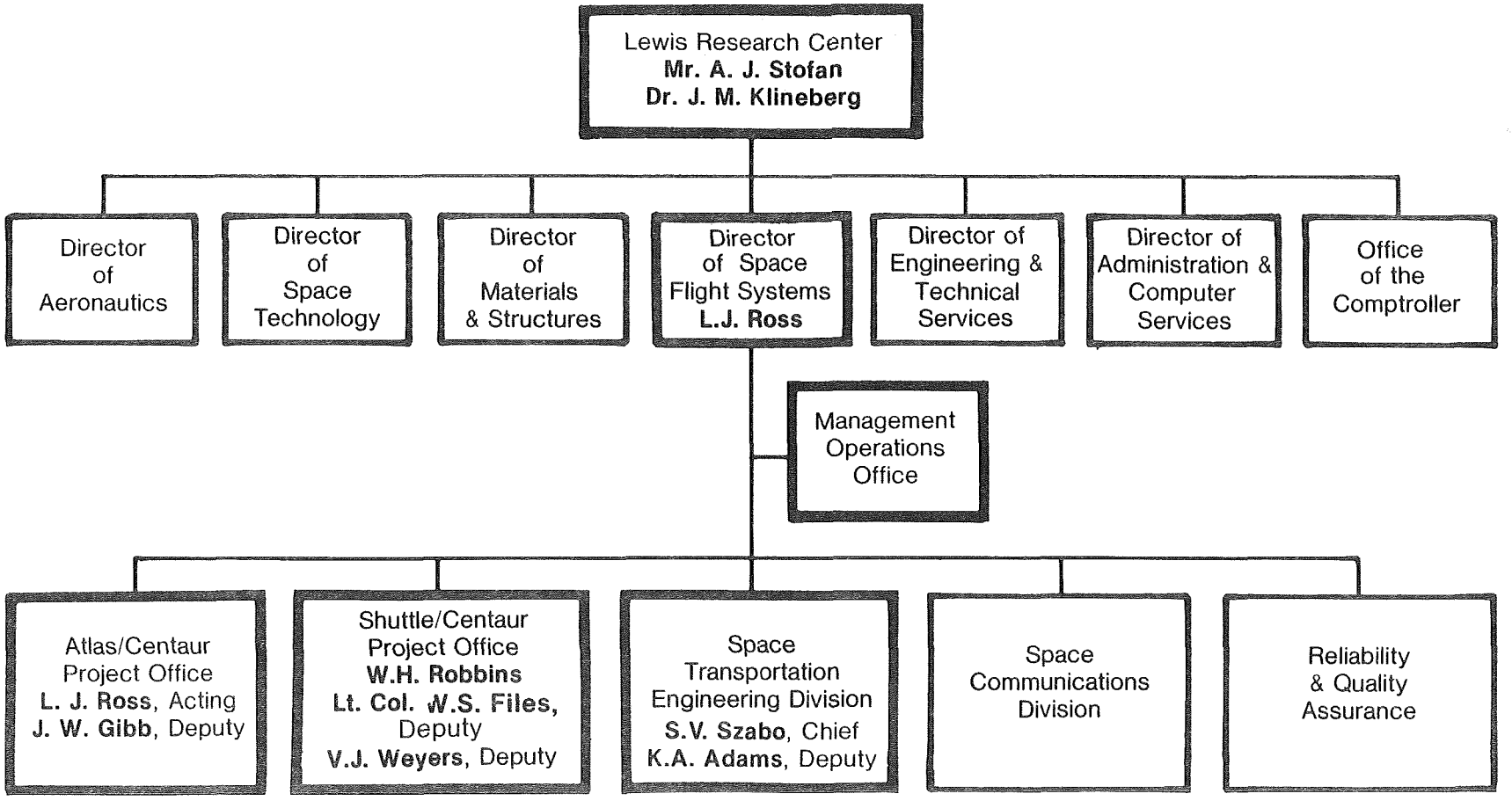


Figure 2

SHUTTLE/CENTAUR IMPLEMENTATION POLICY

- Shuttle/Centaur is a NASA/USAF cooperative program
- Project management has been assigned to a joint NASA/USAF project office at the NASA Lewis Research Center
- Funding is provided by both agencies

Figure 3

SHUTTLE/CENTAUR PROGRAM MANAGEMENT RELATIONSHIPS

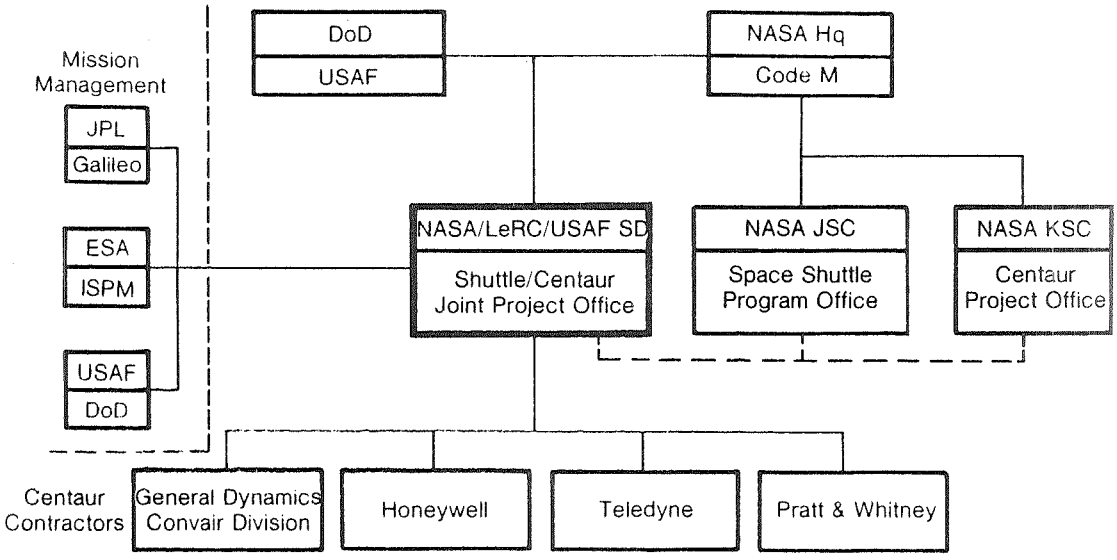


Figure 4

SHUTTLE/CENTAUR REQUIREMENTS

General

- Design & develop a high-energy upper stage for use with Space Transportation System
- Two versions will be developed

USAF

- Performance
  - — 10,000 lb to geosynchronous orbit
  - — 11,500 lb to 12-hr orbit
- Accommodate a 40-ft payload in orbiter/bay
- Support two USAF missions

NASA

- Performance
  - — Meet interplanetary velocity requirements
- Accommodate a 30-ft payload
- Support Galileo & ISPM missions in 1986

Figure 5

CENTAUR INTEGRATED SUPPORT SYSTEM MINIMIZES CHANGES TO SHUTTLE

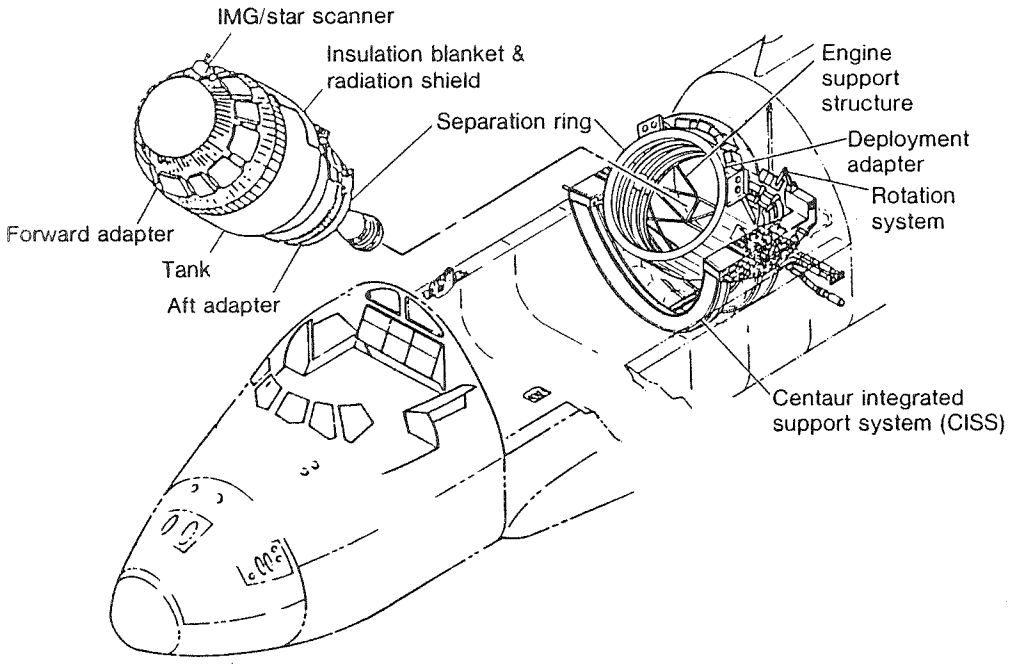


Figure 6

CENTAUR CONFIGURATIONS

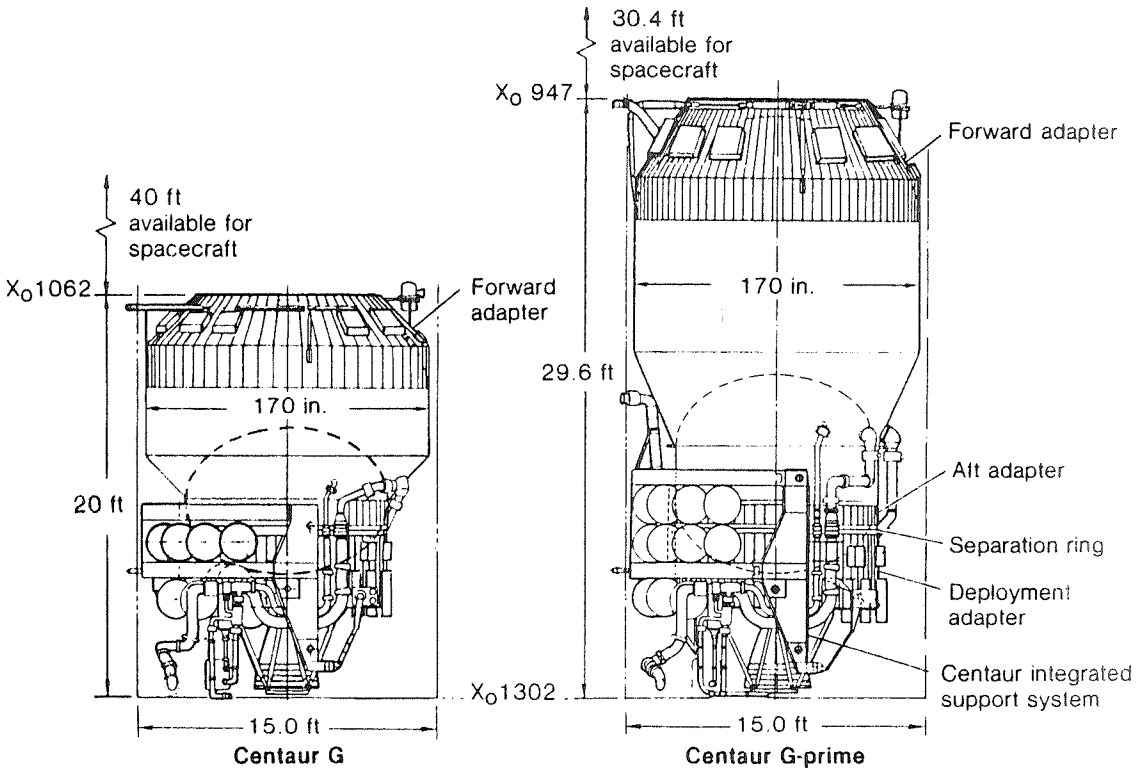


Figure 7

CENTAUR INTEGRATED SUPPORT SYSTEM

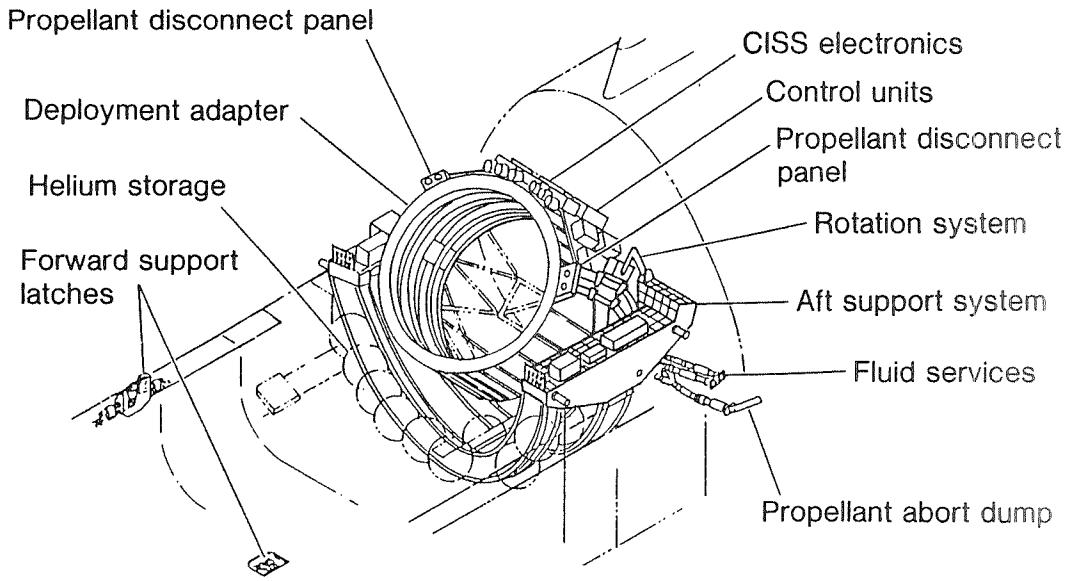
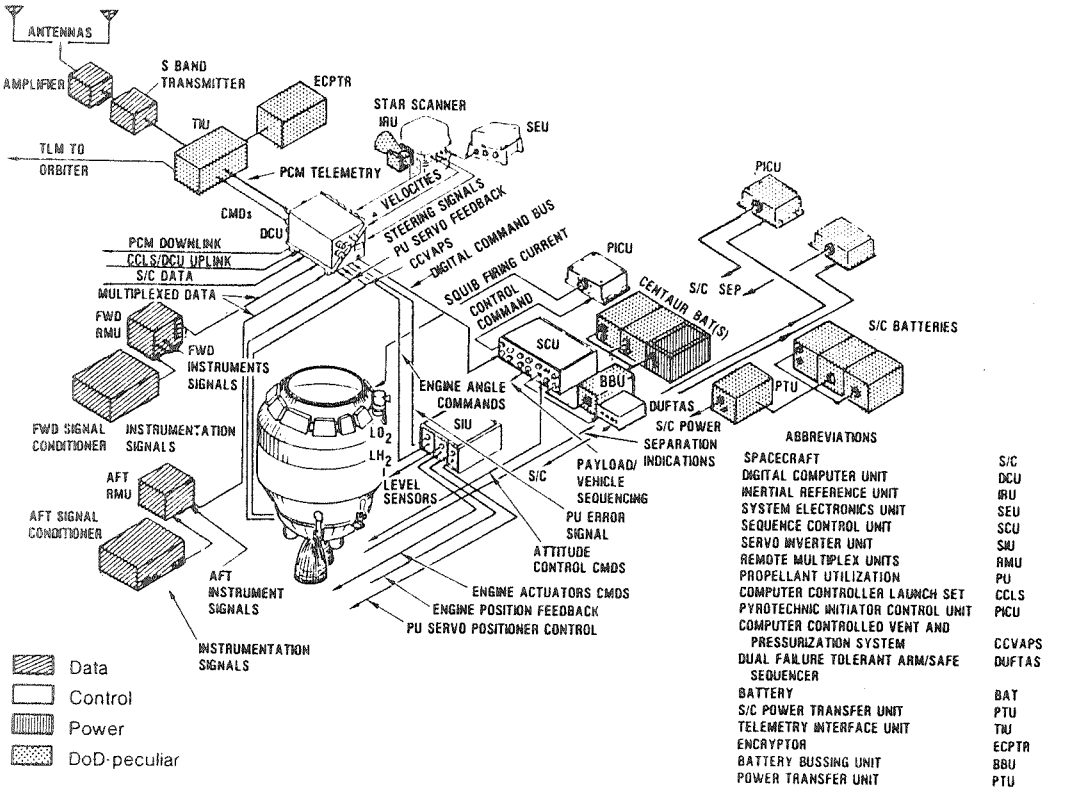


Figure 8

CENTAUR AVIONICS

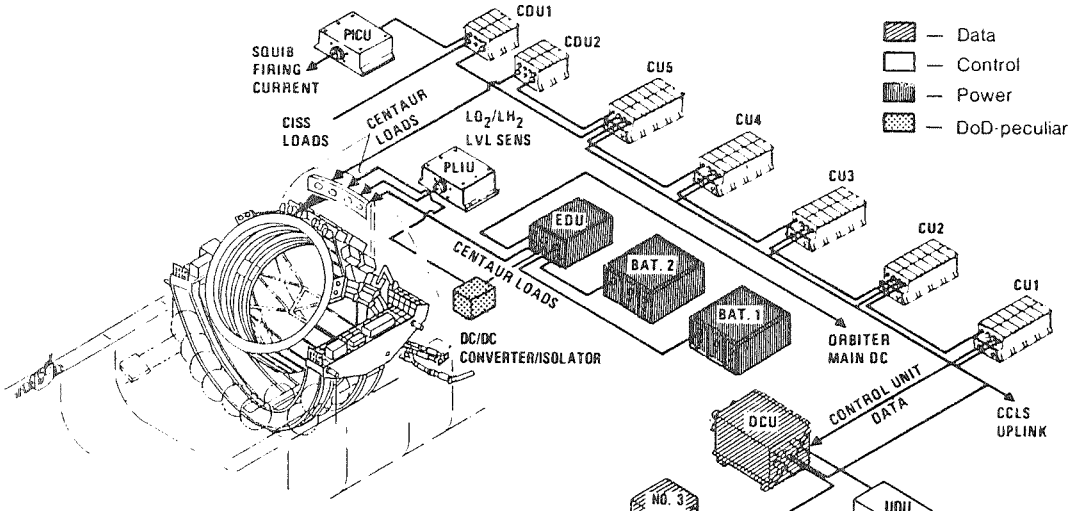


ABBREVIATIONS

SPACECRAFT	S/C
DIGITAL COMPUTER UNIT	DCU
INERTIAL REFERENCE UNIT	IRU
SYSTEM ELECTRONICS UNIT	SEU
SEQUENCE CONTROL UNIT	SCU
SERVO INVERTER UNIT	SIU
REMOTE MULTIPLEX UNITS	RMU
PROPELLANT UTILIZATION	PU
COMPUTER CONTROLLER LAUNCH SET	CCLS
PYROTECHNIC INITIATOR CONTROL UNIT	PICU
COMPUTER CONTROLLED VENT AND PRESSURIZATION SYSTEM	CCVAPS
DUAL FAILURE TOLERANT ARM/SAFE SEQUENCER	DUFTAS
BATTERY	BAT
S/C POWER TRANSFER UNIT	PTU
TELEMETRY INTERFACE UNIT	TIU
ENCRYPTOR	ECPTR
BATTERY BUSSING UNIT	BBU
POWER TRANSFER UNIT	PTU

Figure 9

CISS AVIONICS SYSTEMS

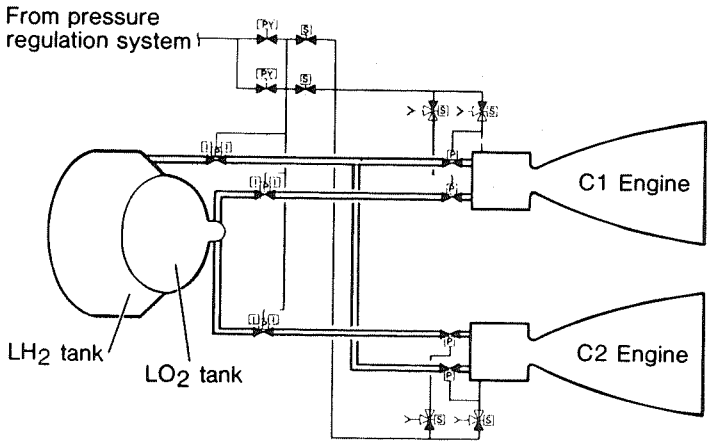


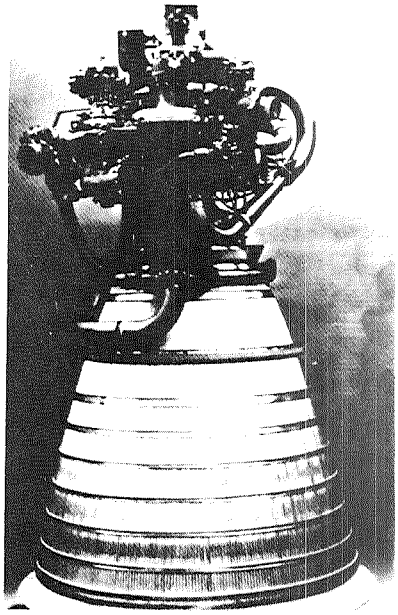
ABBREVIATIONS

DIGITAL COMPUTER UNIT	DCU
CONTROL UNIT	CU
CONTROL DISTRIBUTION UNIT	CDU
REMOTE MULTIPLEXER UNIT	RMU
PROPELLANT LEVEL INDICATING UNIT	PLIU
ELECTRICAL DISTRIBUTION UNIT	EDU
BATTERY	BAT
PYROTECHNIC INITIATOR CONTROL UNIT	PICU
UPLINK DOWNLINK UNIT	UDU

Figure 10

CENTAUR MAIN PROPULSION SYSTEM





	Centaur-G'	Centaur-G
P&W engine	RL10A-3-3A	RL10A-3-3B
Mixture ratio	5:1	6:1
Thrust	16,500 lbf	15,000 lbf
Isp	446.4 sec	440.4 sec

Figure 11

CENTAUR VEHICLE MODIFICATIONS FOR SHUTTLE COMPATIBILITY

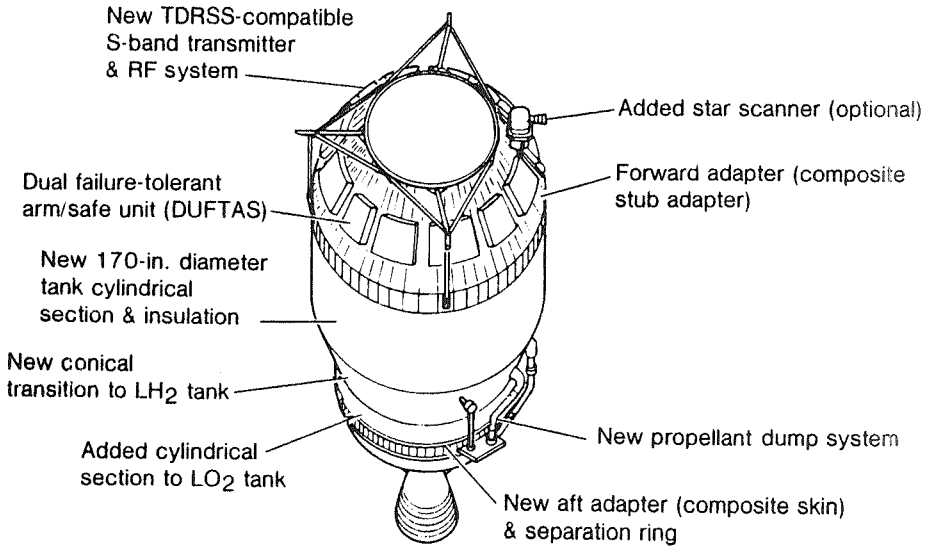


Figure 12

ORBITER MODIFICATIONS
FLUID CONNECT & OUTLET LOCATIONS

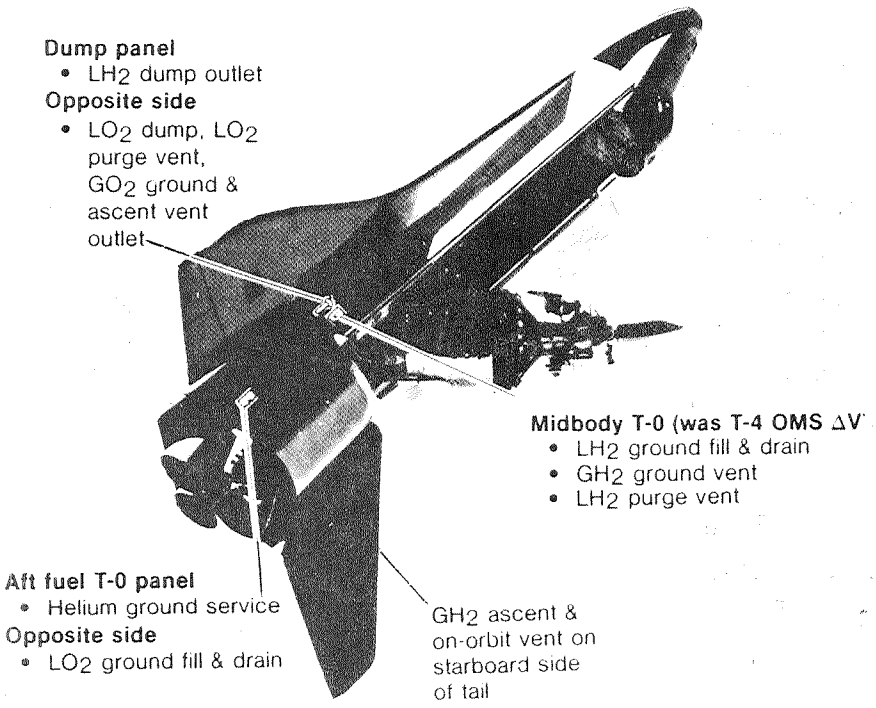


Figure 13

SHUTTLE/CENTAUR LAUNCH OPERATIONS FLOW — ELS

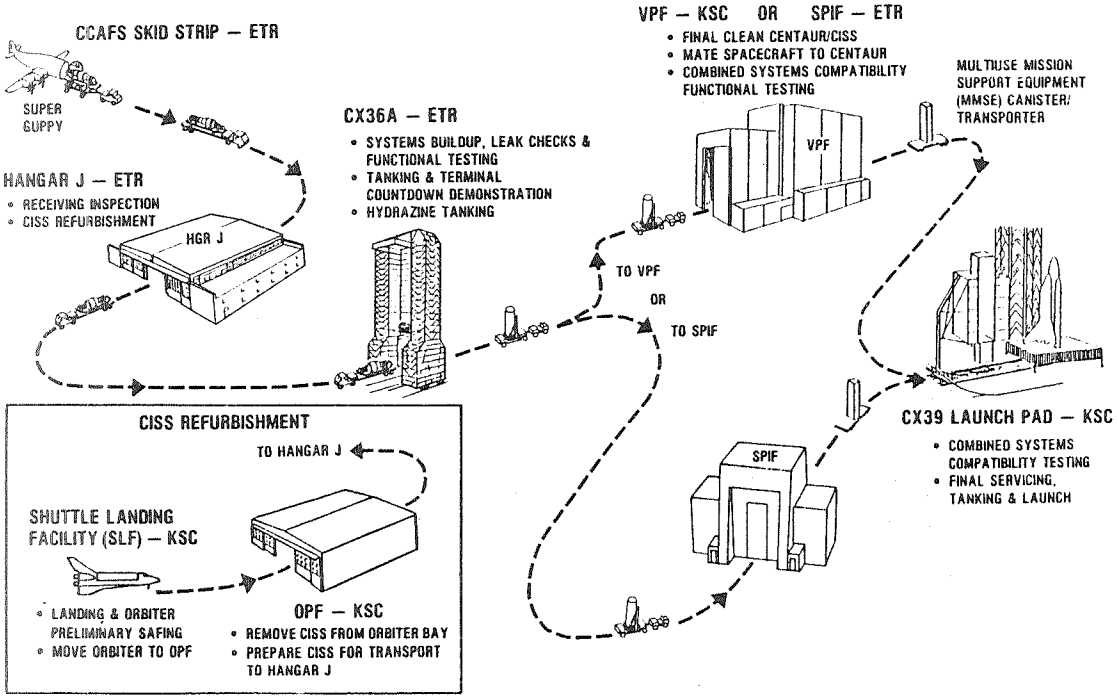


Figure 14

FLIGHT OPERATIONS

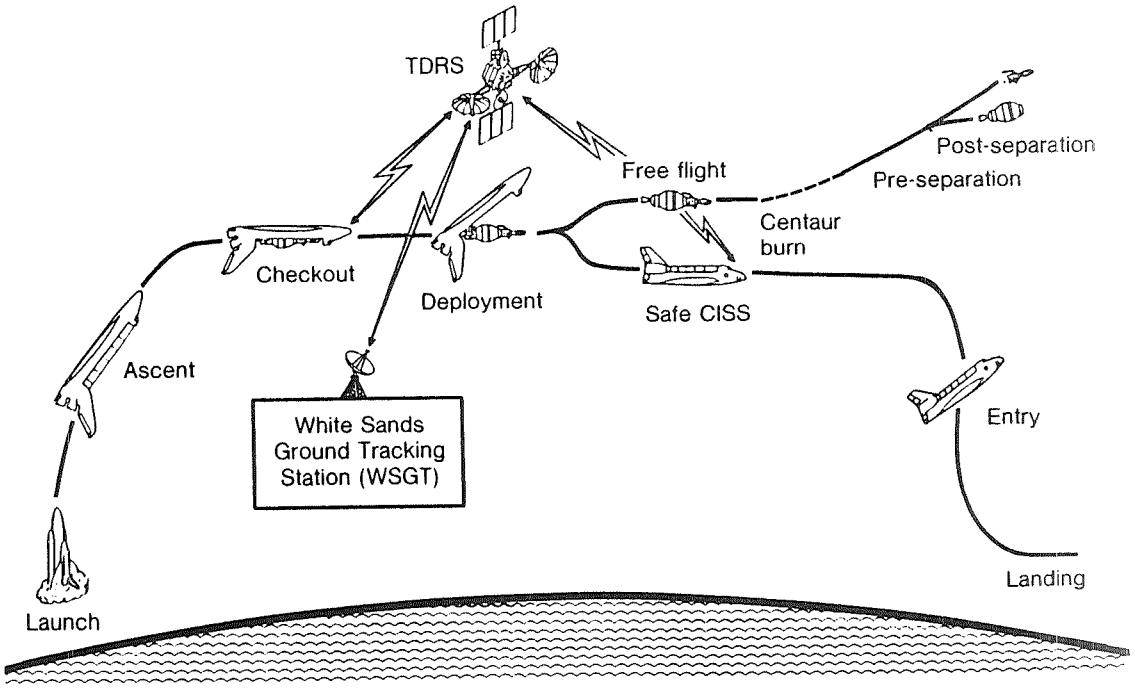


Figure 15

SHUTTLE/CENTAUR INTEGRATED SCHEDULE

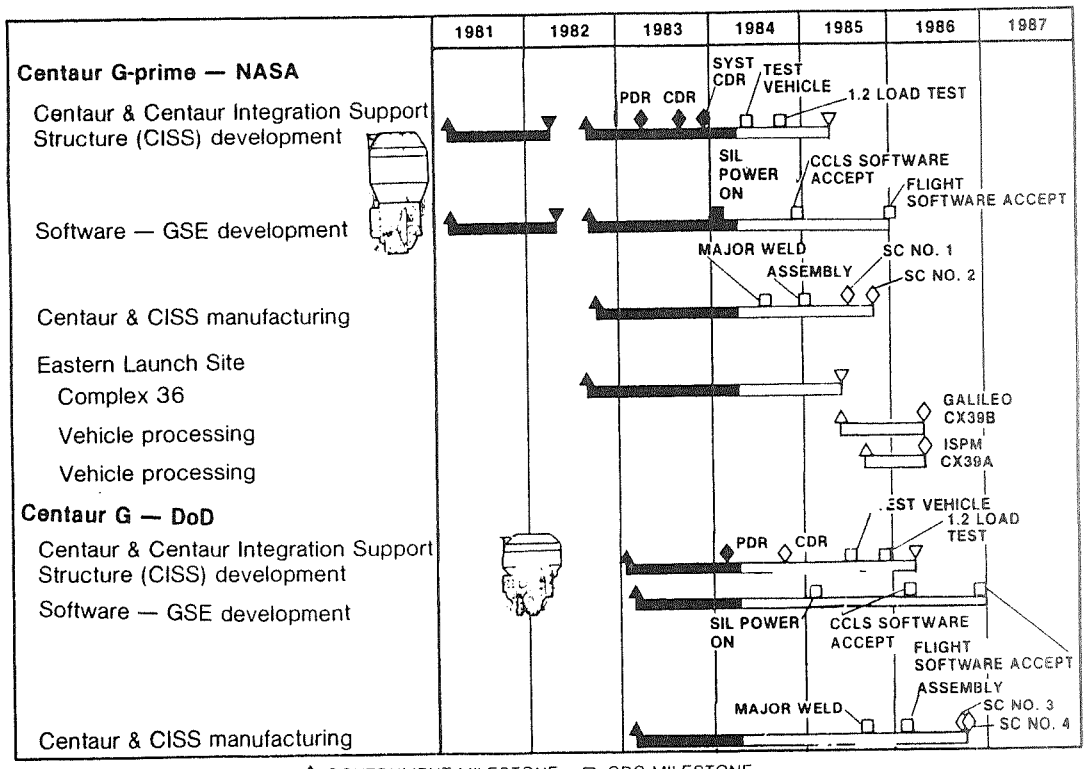


Figure 16

INTERNATIONAL SOLAR POLAR MISSION (ISPM)

- First ever exploration far from ecliptic plane & sun polar region (out of ecliptic)
- Gravitational field of Jupiter used as "sling shot"
- Cooperative program with ESA (European Space Agency)
- Single launch using Shuttle & Centaur
- Weight of spacecraft: 350 kg
- Launch: May 1986

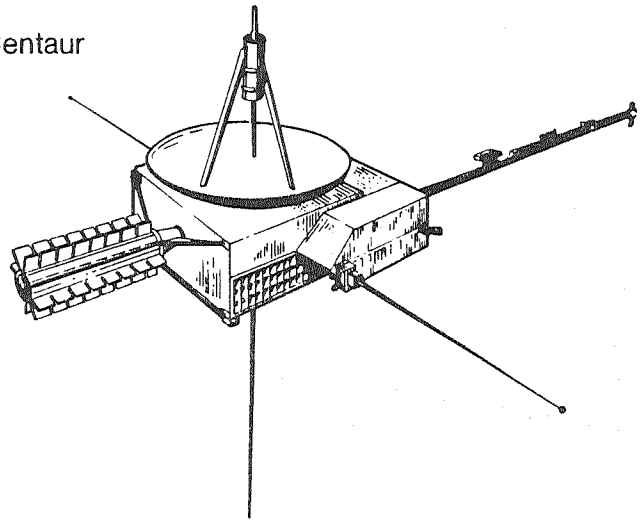
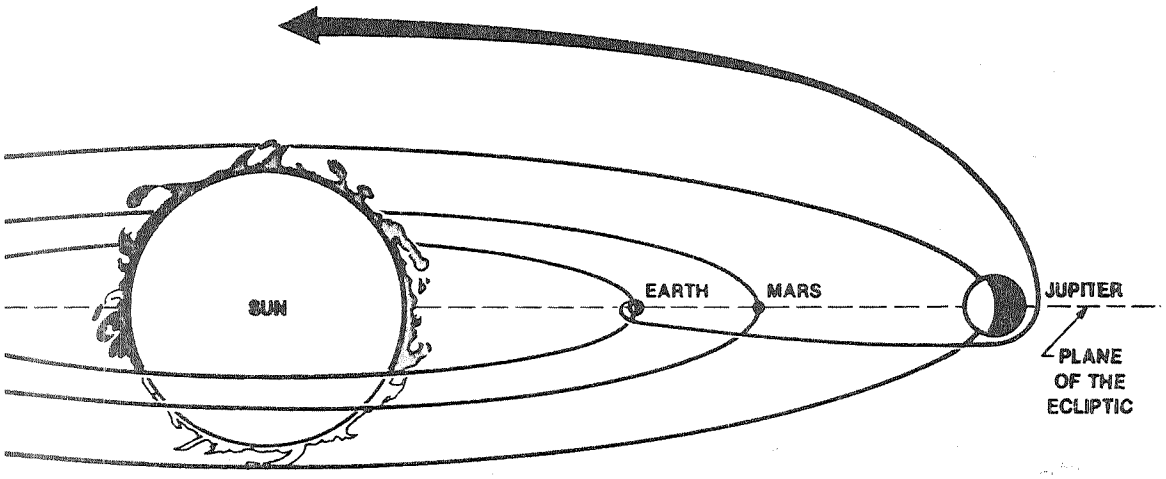


Figure 17

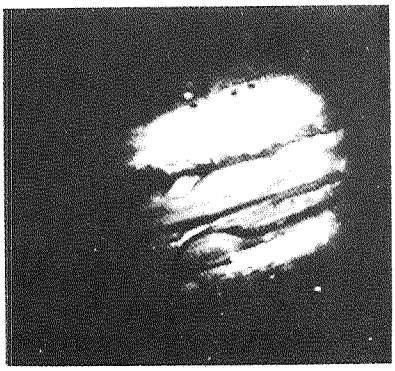
ISPM MISSION



CD-83-14023

Figure 18

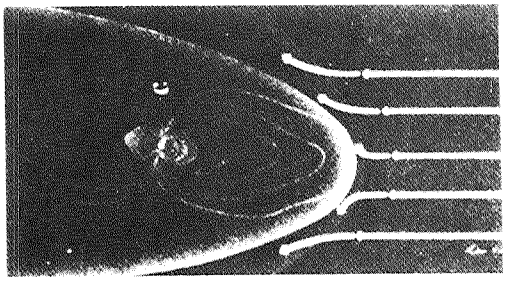
PROJECT GALILEO WILL INVESTIGATE THE . . .



Chemical composition & physical states of the Jovian satellites

Chemical composition & physical state of Jupiter's atmosphere

Structure & physical dynamics of the Jovian magnetosphere



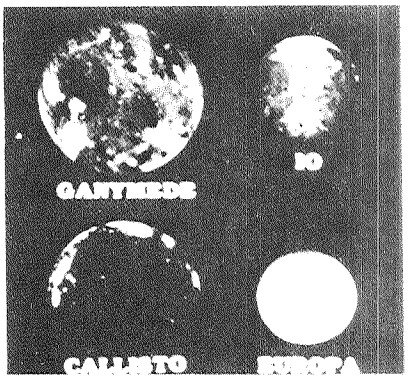


Figure 19

GALILEO

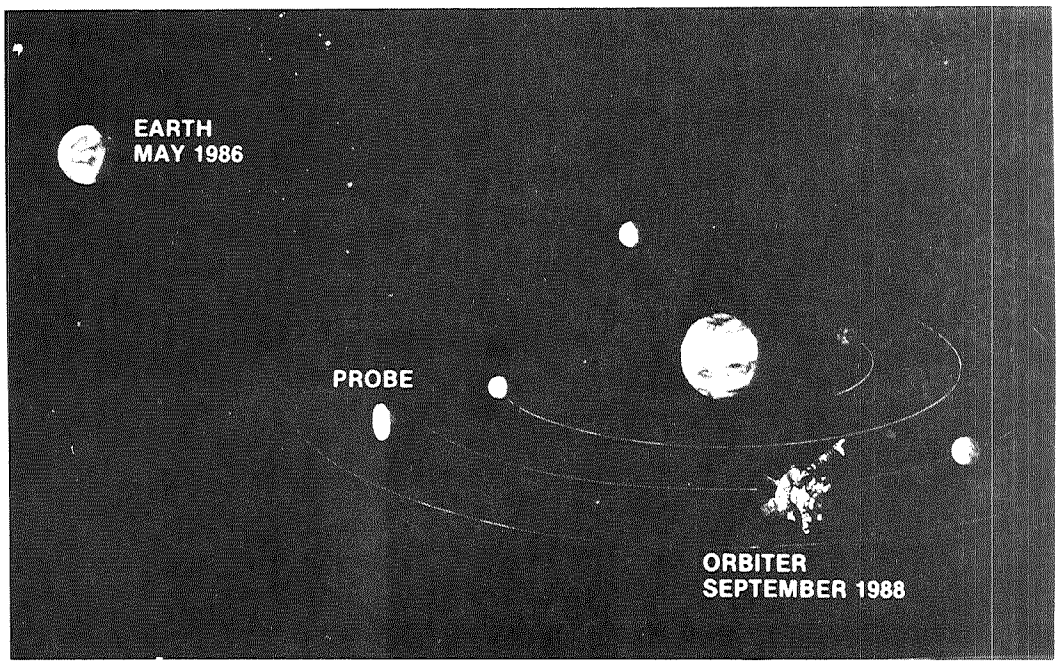


Figure 20