

N91-28264

PRESENTATION 4.4.2

SPACE SHUTTLE REQUIREMENTS / CONFIGURATION EVOLUTION

**E. P. Andrews
Lockheed Space Operations Company**

June 27, 1990

SPACE SHUTTLE

**REPEATED VOYAGES INTO SPACE, RETURN
AND REUSE**

SPACE SHUTTLE

- **1940's, 1950's, EARLY 1960's: TECHNOLOGY NOT AVAILABLE**
 - EMPHASIS ON CONVENTIONAL ROCKETRY
 - EXCEPTIONS: DYNASOAR & FRONT END STEERING

- **MID 1960's: NO WAY TO DESIGN A COMBINED, SINGLE STAGE AIRCRAFT/SPACECRAFT**
 - PROBLEMS: WEIGHT
 - PROPULSION
 - THERMAL PROTECTION

- **TWO VEHICLES REQUIRED**
 - 1) REUSABLE CARGO/PEOPLE CARRIER
 - 2) BOOSTER (REUSABLE OR EXPENDABLE)

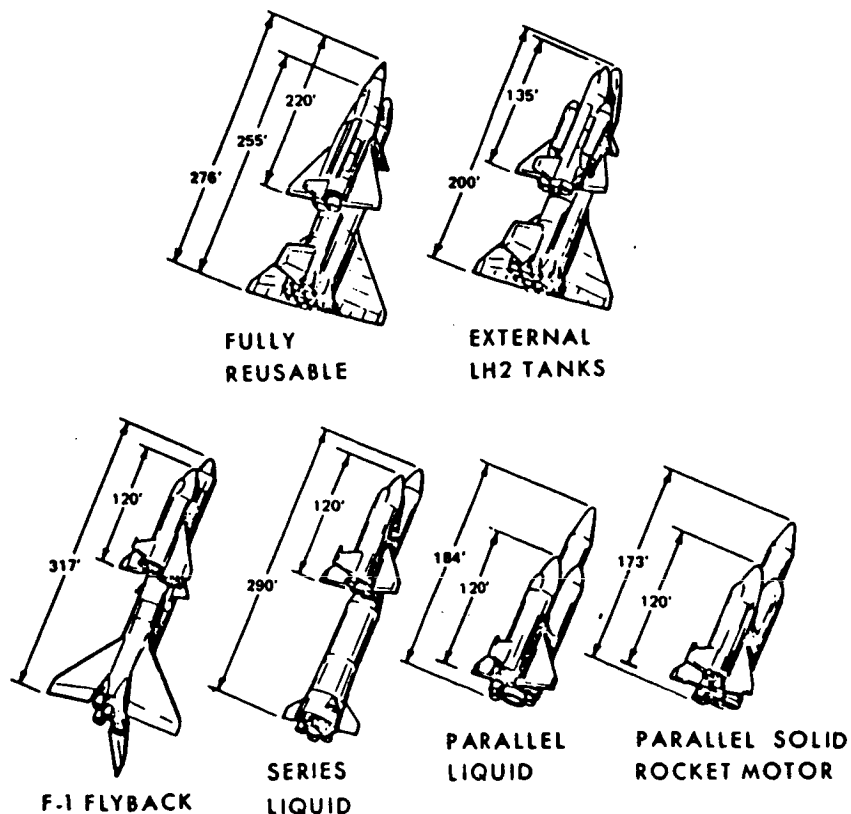
- **DECISION TO PROCEED AND DESIGN ASSISTED BY AEROSPACE TECHNOLOGY ADVANCES**
 - X-15
 - LIFTING BODIES
 - MERCURY, GEMINI, APOLLO
 - SUPERSONIC MILITARY & AIR TRANSPORT AIRCRAFT

- **FALL 1969: REUSABLE SPACE TRANSPORTATION SYSTEM**
 - TECHNICALLY FEASIBLE
 - ECONOMICALLY JUSTIFIED

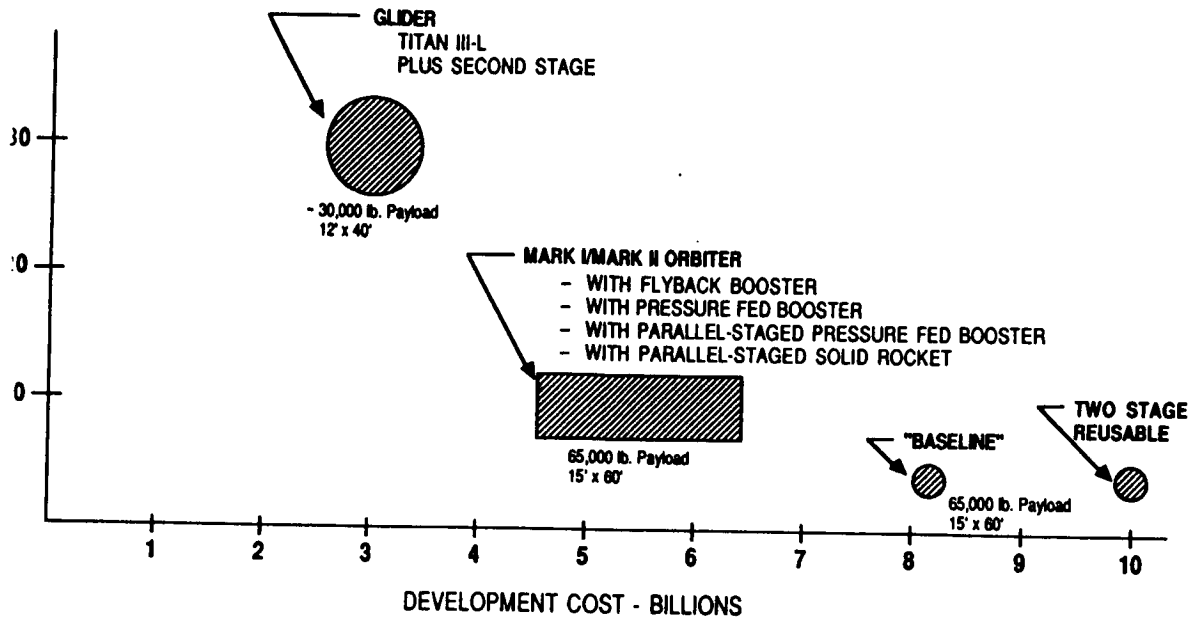
SPACE SHUTTLE CHRONOLOGY

- NASA DOD JOINT REPORT TO THE SPACE TASK FORCE JUNE 1969
- FEASIBILITY STUDIES WITH INDUSTRY (PHASE A) FEB. - NOV. 1969
- SPACE SHUTTLE SYMPOSIUM - SMITHSONIAN INST. OCTOBER 1969
- DEFINITION STUDIES WITH INDUSTRY (PHASE B) JUN. 1970 - MAR. 1972
- REVIEW BY PRESIDENT'S SCIENCE ADVISOR AUG. 1971 - JAN. 1972
- MATHEMATICA REPORT ON SHUTTLE ECONOMICS JANUARY 1972
- PRESIDENT NIXON'S SHUTTLE ANNOUNCEMENT JANUARY 1972
- NASA DECISION ON SHUTTLE CONFIGURATION MARCH 1972

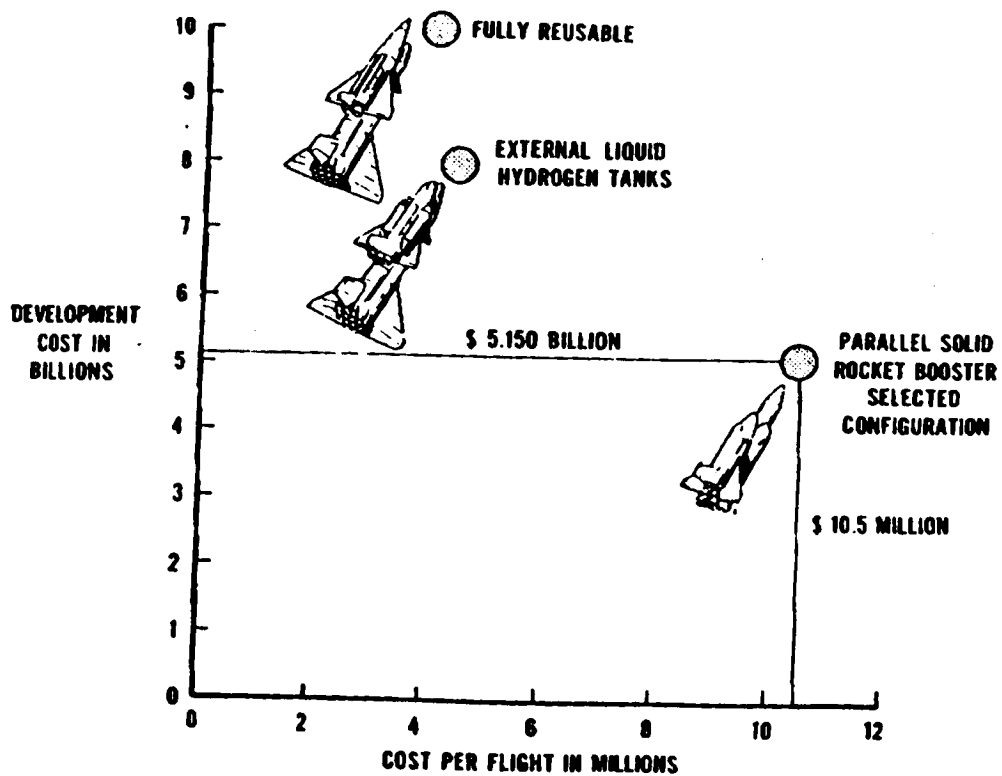
SPACE SHUTTLE COMPARISON



SPACE SHUTTLE COST COMPARISON (1971)



SPACE SHUTTLE COST COMPARISON (1971 Dollars)



PROGRAM GROUND RULES

- **MINIMIZE DEVELOPMENT COSTS**
 - DDT&E - \$5.15B (1971\$)
- **MINIMIZE COST PER FLIGHT**
 - CPF - \$10.5M (1971\$)
- **MAXIMIZE PAYLOAD ACCOMMODATIONS TO SATISFY USERS**

SPACE SHUTTLE PERFORMANCE

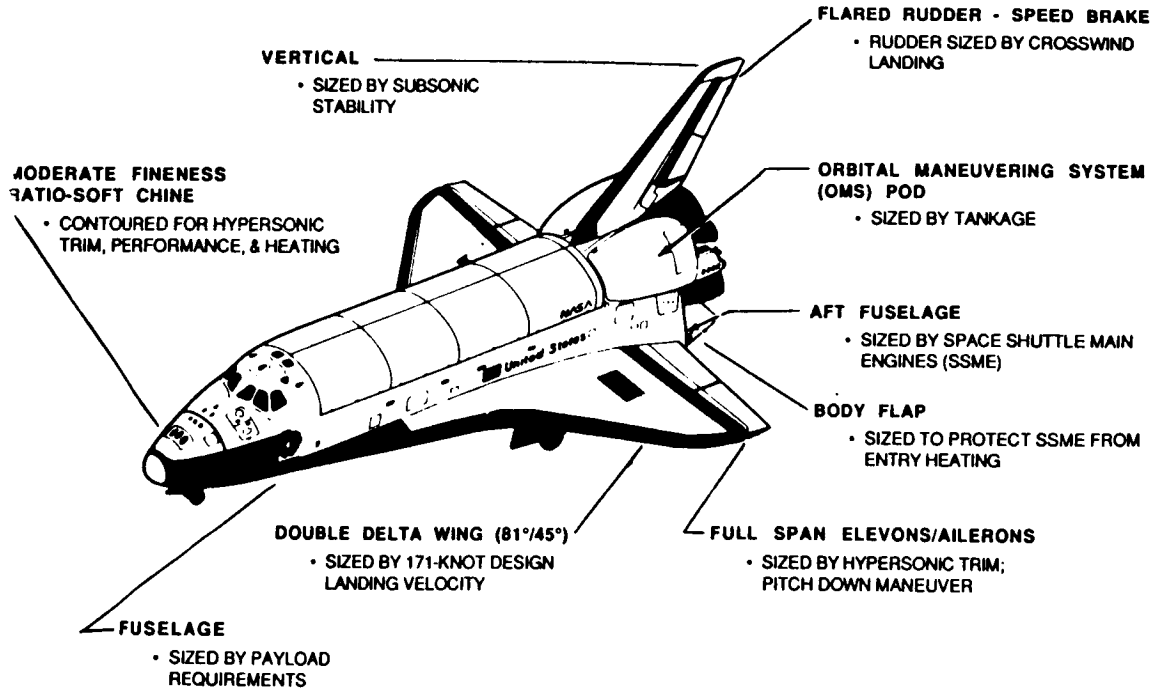
BASELINE

- 7 DAYS MISSION DURATION WITH CREW OF FOUR
- 65,000 LBS TO 100 x 100 MI DUE EAST ORBIT/32,000 LBS TO 100 x 100 MI 104° INCLINATION ORBIT
- 32,000 LBS DOWN PAYLOAD

EXTENSION KITS

- UP TO 30 DAYS DURATION WITH CREW UP TO SEVEN (ELECTRICAL POWER/LIFE SUPPORT/CREW PROVISIONS/PROPELLANTS)
- ORBIT ALTITUDES UP TO ~ 650 MI WITH VARYING PAYLOAD WEIGHTS AT VARIOUS INCLINATIONS (ORBITAL MANUEVERING SYSTEM PROPELLANT KITS)

ORBITER SIZING CRITERIA



CREW/PASSENGER PROVISIONS

• EARTH-LIKE ENVIRONMENT

- CABIN ATMOSPHERE IS OXYGEN-NITROGEN AT 14.7 PSI
- TEMPERATURE REGULATED 65 - 80°F (+/- 2.0°F)
- HUMIDITY CONTROL
- CARBON DIOXIDE CONTROL

• HOT AND COLD FOOD

• PROTECTED SLEEP STATIONS

• MALE AND FEMALE HYGIENE PROVISIONS

• MAXIMUM ACCELERATION IS 3 G's

SPACE SHUTTLE MAIN ENGINE CHARACTERISTICS

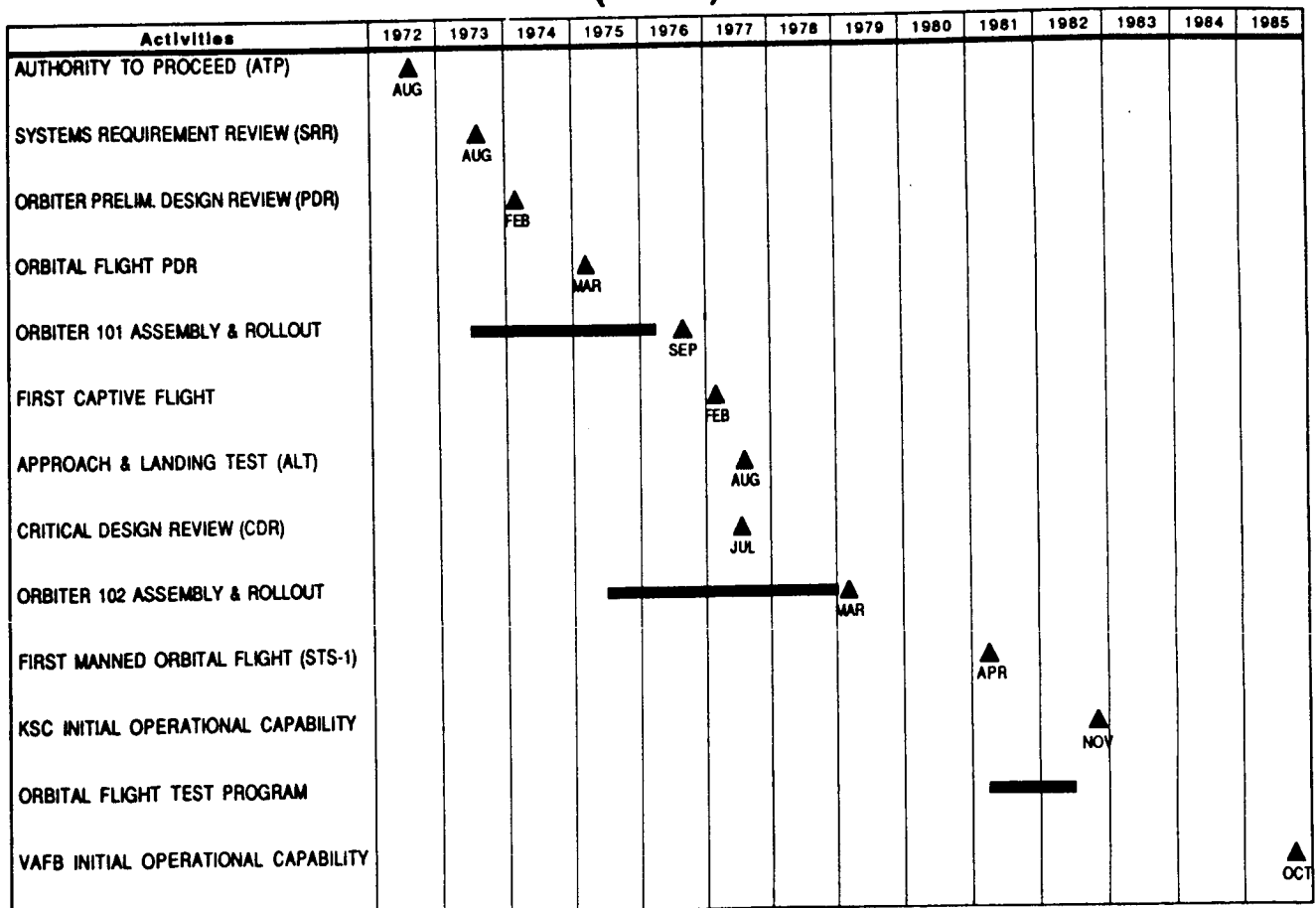
• THRUST

- SEA LEVEL 375 KLBS
(1,668,080 N)
- VACUUM 470 KLBS
(2,090,660 N)

- CHAMBER PRESSURE 2970 PSIA
(2048 N/CM²)

- LIFE 7.5 HOURS
55 STARTS

SPACE SHUTTLE PROGRAM MILESTONES (1983)



SPACE SHUTTLE REQUIREMENTS

- **RETURNABLE, REUSABLE SPACE HARDWARE**
- **PAYLOAD WEIGHT, VOLUME & ALTITUDES**
 - Down Payload
- **SUPPORTING SYSTEMS FOR PAYLOADS**
 - Pointing & Stability
- **CROSS RANGE**
- **CROSS WIND LANDINGS**
- **ORBITAL INCLINATIONS: 29° TO 104°**
- **CREW ACCOMMODATIONS**
- **EVA**
- **CONTINUOUS ABORT PATHS**
- **ELECTRICAL POWER**
- **ENVIRONMENTAL CONTROL**
- **COMMUNICATIONS, TRACKING & DATA MANAGEMENT**
- **GN&C**
- **MISSION KITS**
- **COSTS: DEVELOPMENT & PER FLIGHT**

DROPPED IN EARLY 1970's: Separate Solid-Fuel Rockets For Abort From The Launch Pad and Jet Engines For Orbiter Flyback