NAS8-37136

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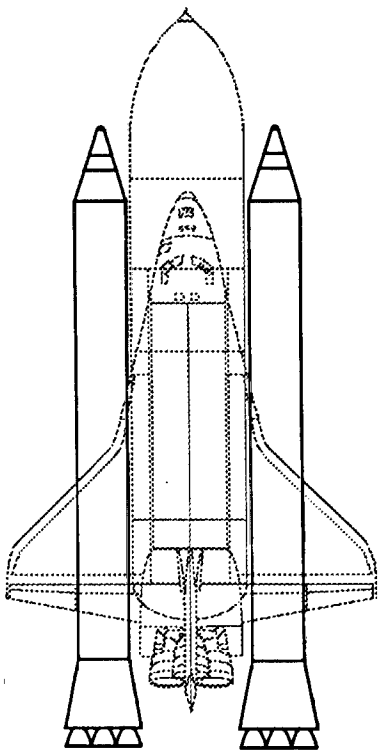
Pg. 17

September 1990

Liquid Rocket Booster (LRB) for the Space Transportation System (STS) Systems Study

Amendment #13
Orientation Meeting



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Agenda

- **Contract Overview**
- **Task 5 Study Plan**
  - Ground rules and assumptions
  - Schedule

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LRB For The STS Systems Study

Contract No: NAS8-37136

Contract Value: $4.0M

Contract Duration: October, 1987 - February, 1991

Study Product: Part 1 - Optimum pump-fed and pressure-fed LRB concepts to replace the Space Shuttle SRBs

Part 2 - Concepts definition

Part 3 - Concepts optimization
LRB test bed support
Alternate LRB applications study

Part 4 - ET impacts for the LO2/LH2 LRB
LRB propulsion/avionics recovery module

Part 5 - Technology application to large propellant tanks design & production
LRB applications for heavy lift launch vehicles (HLLV)
LRB propulsion and avionics module recovery
ET derived PLS/CRV launch vehicle

Part 6 - ET derived stage and a half launch vehicle

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LRB Study Results Summary – February 1989

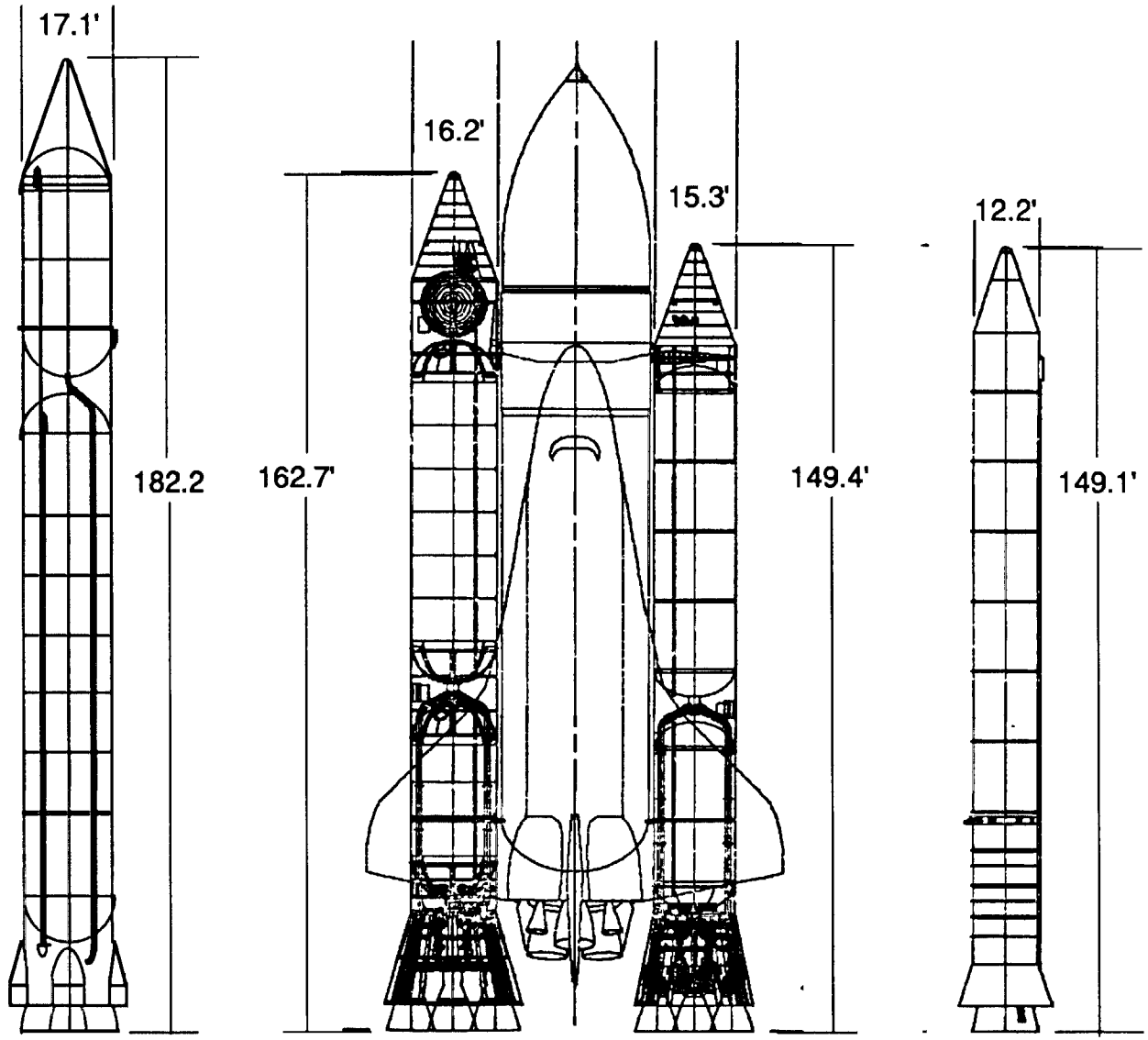
- LO2/RP-1 is the recommended propellant for both the pump and pressure-fed systems
- Both pump and pressure-fed vehicles are expendable
- Both vehicles can be flown within current Space Shuttle constraints
- There are no enabling technology requirements for the pump-fed system
- Technology requirements for the pressure-fed system involve high specific strength materials, large propellant tank pressurization systems demonstration and large, low Pc thrust chamber characterization
- High potential exists for the Space Shuttle/LRB program and ALS program to mutually develop a liquid rocket booster common to both launch vehicles

Liquid rocket boosters are a viable alternative to solid rocket boosters for the Space Shuttle System

LRB Study Results - January 1990

- LO2/RP-1 are the preferred propellants for an LRB to be integrated into the NSTS
- STS optimized LO2/LH2 LRBs can be flown with the shuttle system with "acceptable" structural impact to the external tank
- LRB engine cost is the primary discriminator between pump and pressure-fed options
- Recovery of high cost propulsion systems is feasible with increased DDT&E and production costs

Shuttle Configuration With Booster Options



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LRB Study Results - September 1990

- Aluminum lithium material development program would support an LRB program with an IOC of 1998
- Reusable STE P/A module provides a 5% LCC savings over expendable booster costs
- Reusable/expendable study results are sensitive to numerous assumptions
- ET derived launch vehicle concepts can meet performance requirements for both the PLS and CRV

Agenda

- **Contract Overview**

➡ • **Task 5 Study Plan**
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LRB SOW Tasks (C.O. #13)

- **Task 5a - Design**

  Develop a conceptual design for a 1.5 stage inline launch vehicle derived from the STS configuration External Tank (ET) to determine the design impacts to the ET.

- **Task 5b - Manufacturing/Production**

  Define manufacturing/production impacts at MAF for ET derived 1.5 stage launch vehicle.

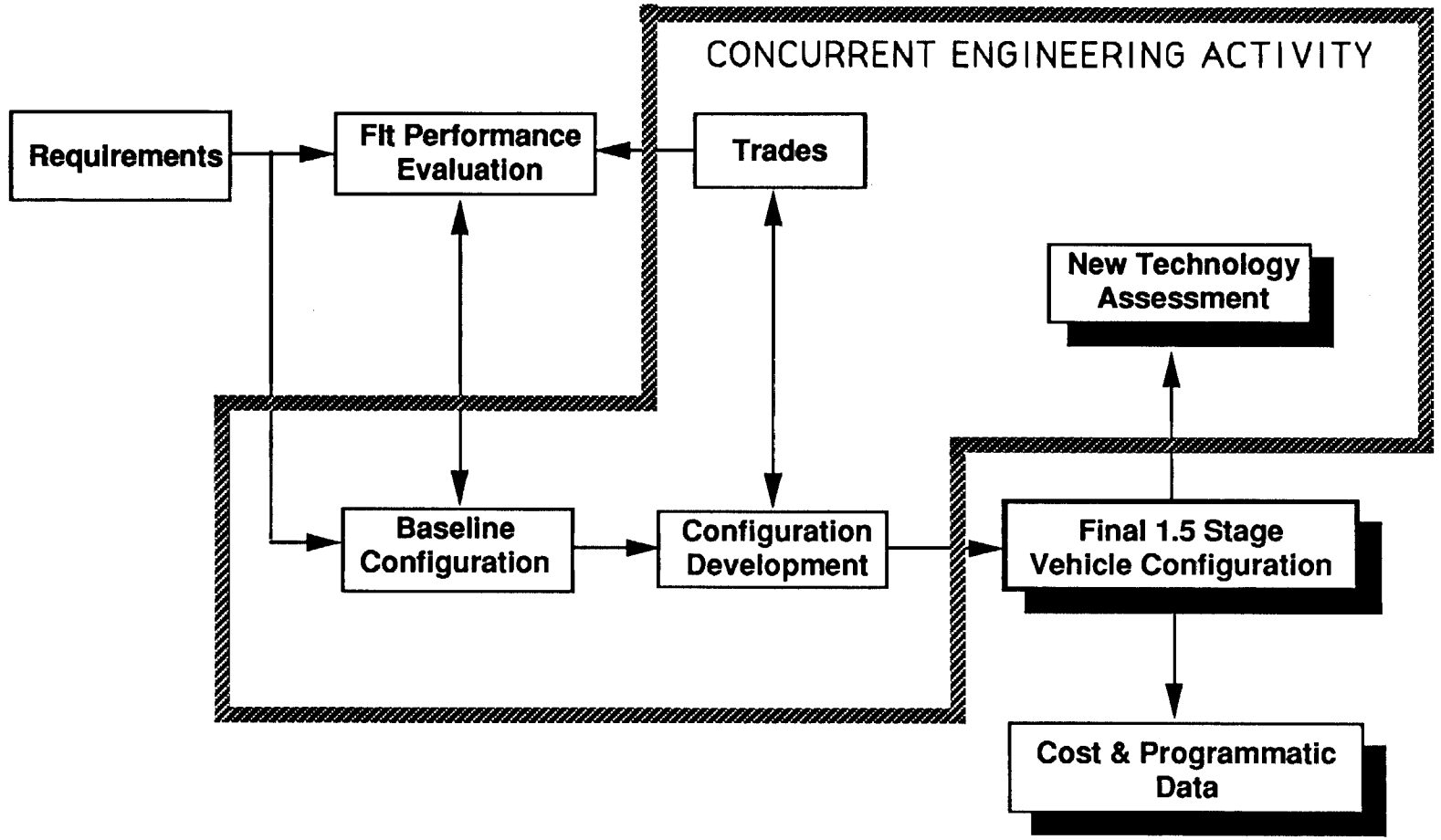
- **Task 5c - Test Program/Certification**

  Quantify the delta ET test certification program required due to the ET changes

Groundrules & Assumptions

- **Manrated Vehicle**
- **Payload : PLS (weight </= 50klbs)**
- **Engine out capability at L.O.**
- **P/L Delivery Orbit : 50 x 100 nm**
- **Concurrent MAF Build : 12 STS ETs + 7 PLS Launch Vehicles**
- **Vehicle Integration Options**
  - Total integration at MAF
  - Vehicle and P/A Module integration at KSC
- **Expendable Engine Module Utilizes STMEs**
- **Recoverable P/A Module utilizes either SSMEs or STMEs**

Study Flow - Task 5a: Design



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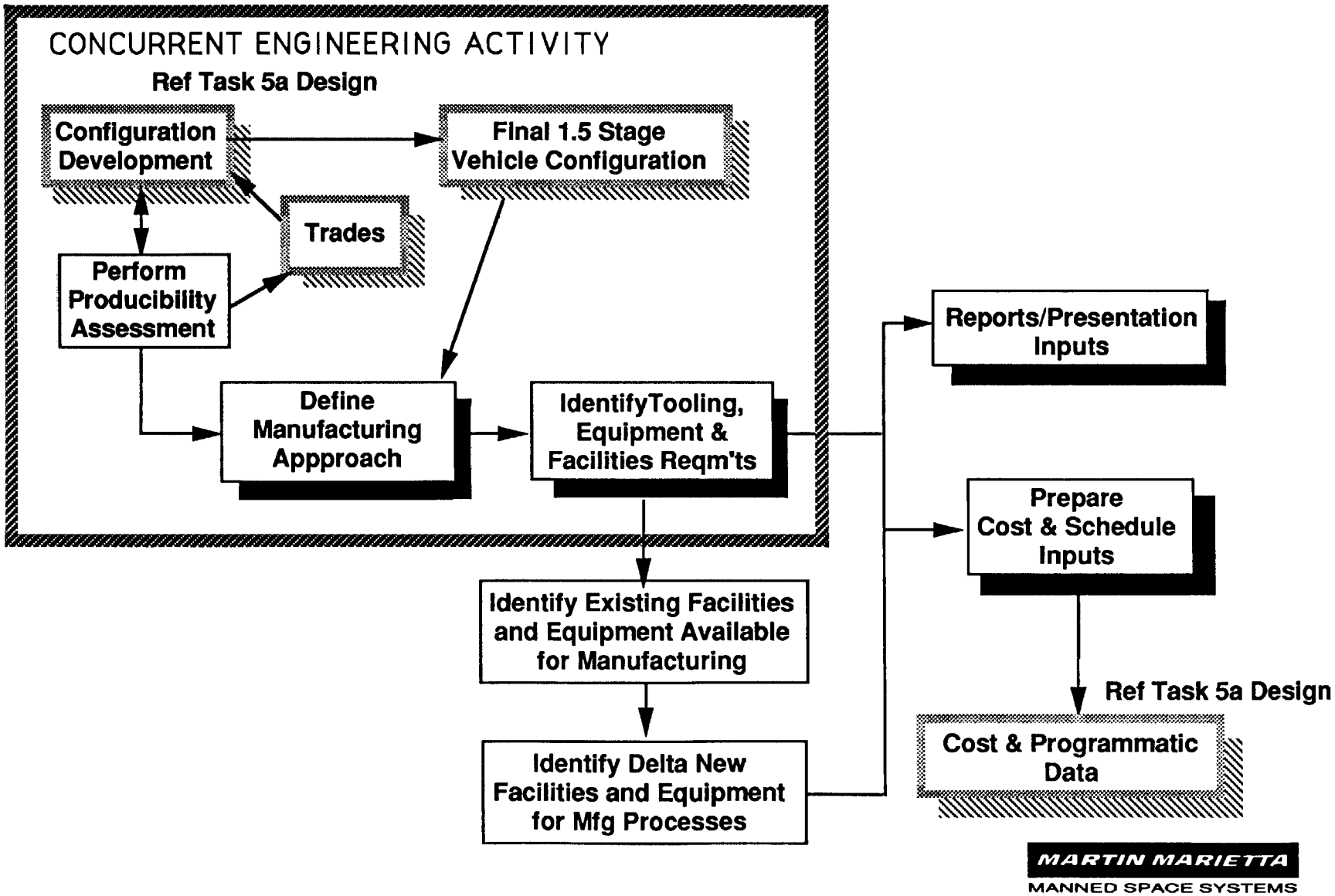
Study Flow - Task 5b: Manufacturing/Production



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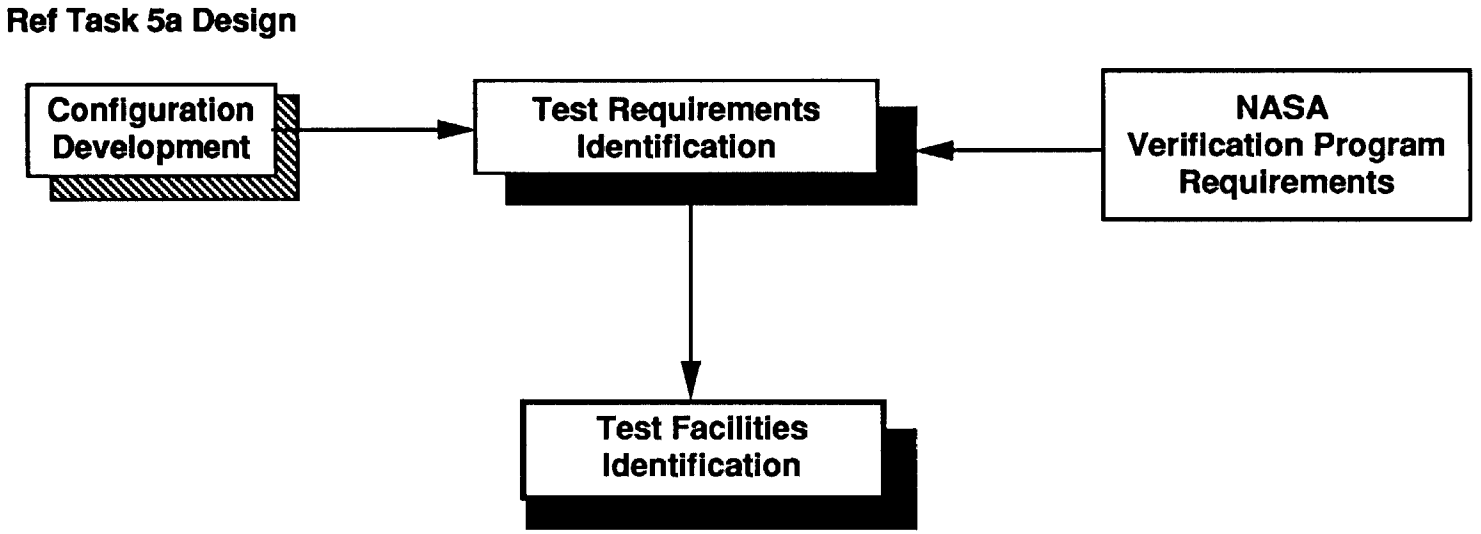
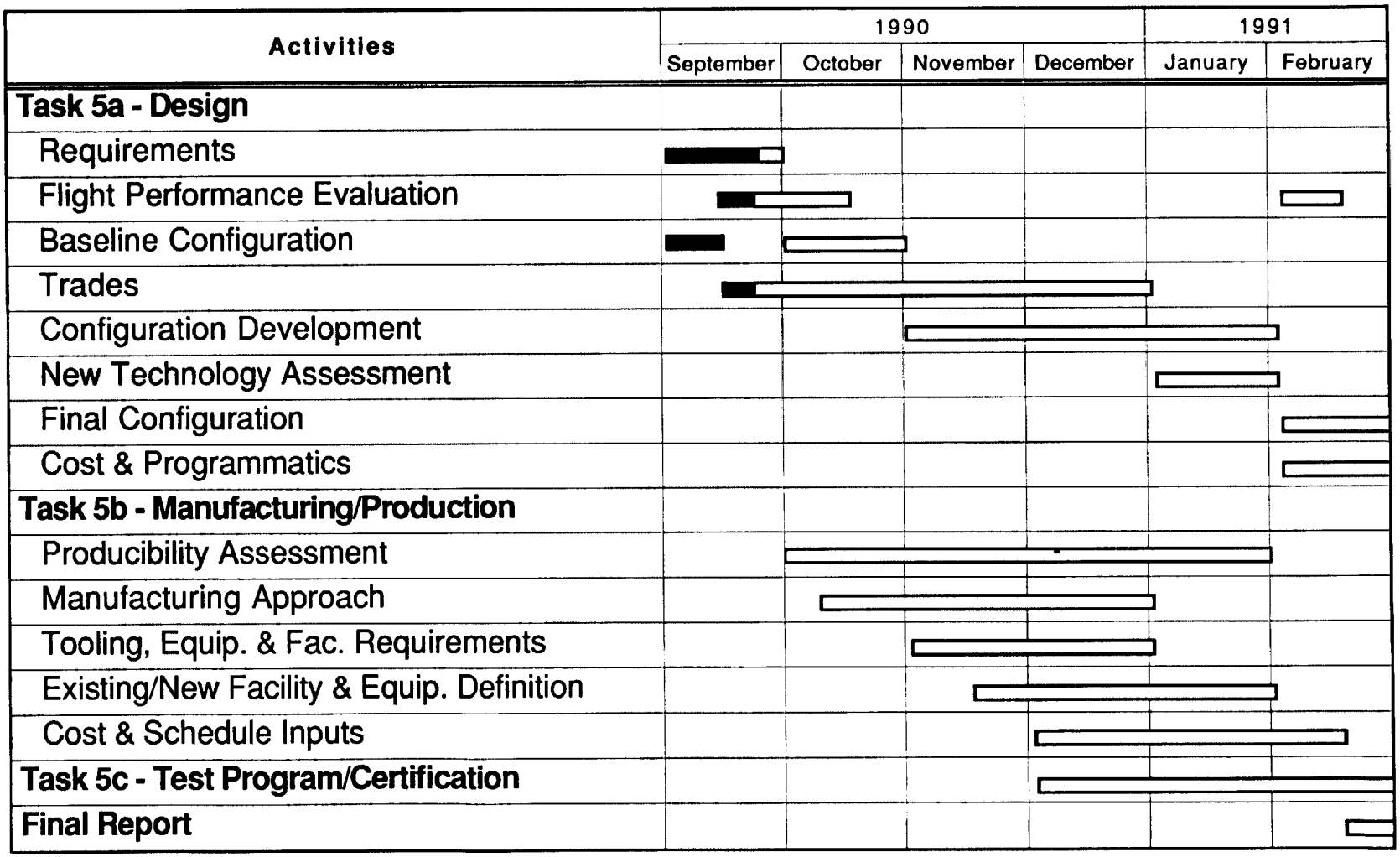
Study Flow - Task 5c: Test Program/Certification



Study Products

- Concept Design Layouts
- Systems Descriptions
- ET Impact Descriptions
- Trade Results
- Program Cost
- Program Schedule
- Test Requirements/Facilities Identification
- Final Report Addendum

Study Schedule - LRB Contract (C.O. #13)



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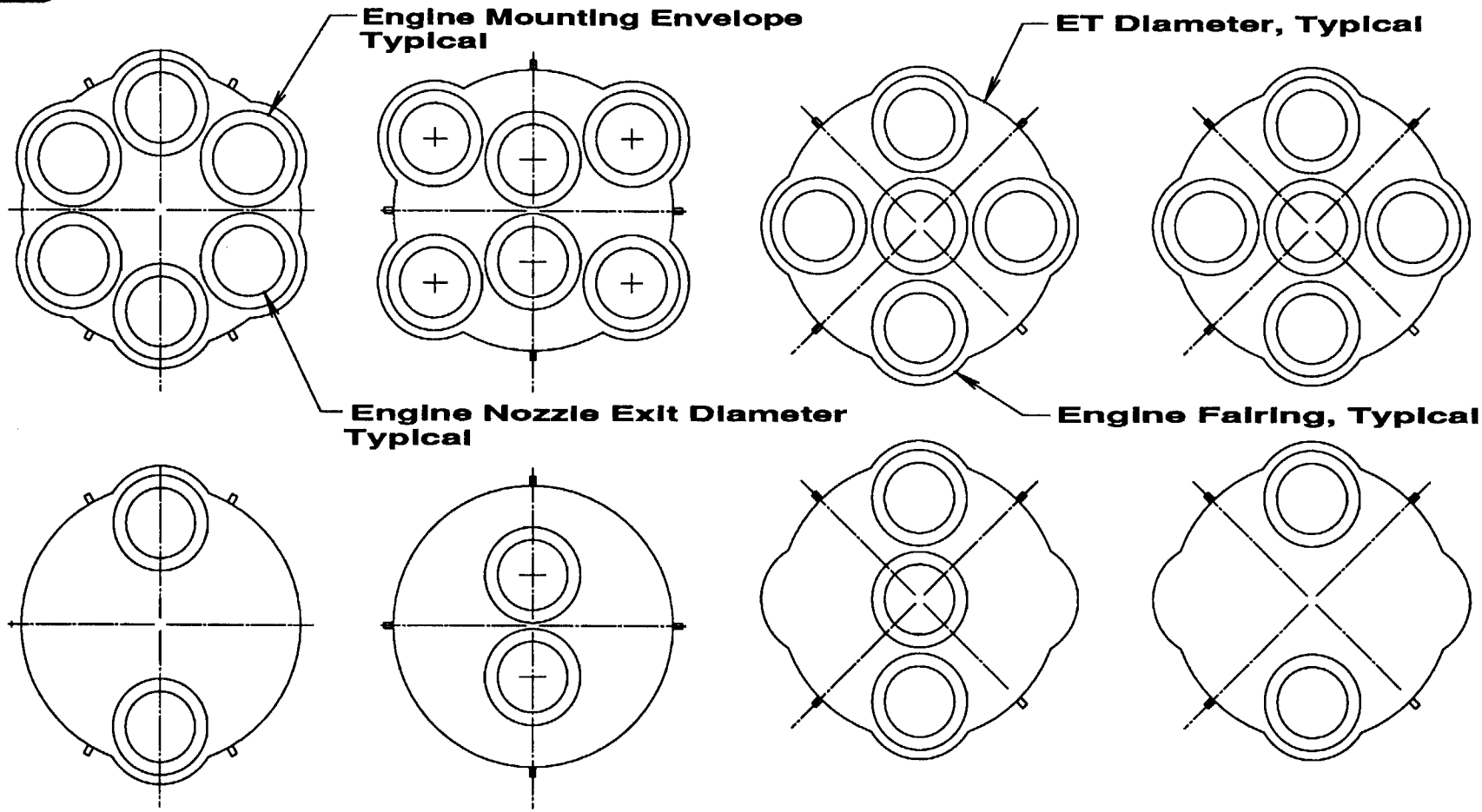
Candidate 1.5 Stage Engine Arrangements



STE Engine (Drawn):
Mounting Envelope = 113"
Nozzle Exit Diameter = 84"

SSME Engine (Not Shown):
Mounting Envelope = 99"
Nozzle Exit Diameter = 94"