UEET Integrated Inlet Propulsion System Study (IIPSS) Program

Dr. C. Frederic Smith
Program Manager

Allison Advanced Development Company
Indianapolis, IN

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Program Overview

- Determine optimum supersonic business jet (SSBJ) airframe/propulsion system that minimizes sonic boom and maximizes aircraft performance for Mach 1.6-2.0 overland flight conditions

- Meet Stage 4 noise requirements

- Assess impact of possible future regulatory emissions requirements

- AADC/Rolls-Royce provide propulsion system support (engine and exhaust)

- Lockheed Martin and Gulfstream provide propulsion/airframe integration studies including the inlet

Program Objectives

- **Study two vehicle integrated propulsion systems:**
  - **- High Bypass Ratio (HBR) engine**
  - **- Highly Variable Cycle (HVC) engine**

- **Include inlet and nozzle in studies that minimize sonic boom for each propulsion system.**

- **Technology availability date (TAD) of 2010**

- **Entry into service (EIS) of 2015**

Integrated Propulsion Systems Determination

NASA Glenn Research Center (GRC) in consultation with AADC/Rolls-Royce and the airframers will downselect the integrated propulsion system concept

•AADC/Rolls-Royce will consult with GRC and airframers in downselection of propulsion system components and technologies

•AADC/Rolls-Royce will determine the Technology Readiness Level (TRL) of all critical and/or enabling propulsion technologies

•AADC/Rolls-Royce will develop Technology Roadmaps for all critical and/or enabling propulsion technologies

Fixed Cycle Engine

Relative to highly variable cycle engine:

Advantages:

- **Simpler mechanically**
- **Lower maintenance**
- **Conventional turbomachinery (reliable)**

Disadvantages:

- **Less flexible air flow schedule across flight regime**
- **Engines typically sized to meet take-off noise requirement**

Variable Cycle Engine

Relative to a high bypass ratio fixed cycle engine:

Advantages:

- More flexible airflow scheduling across flight regime
- Potential to better match aircraft thrust requirements at take-off, transonic and cruise points

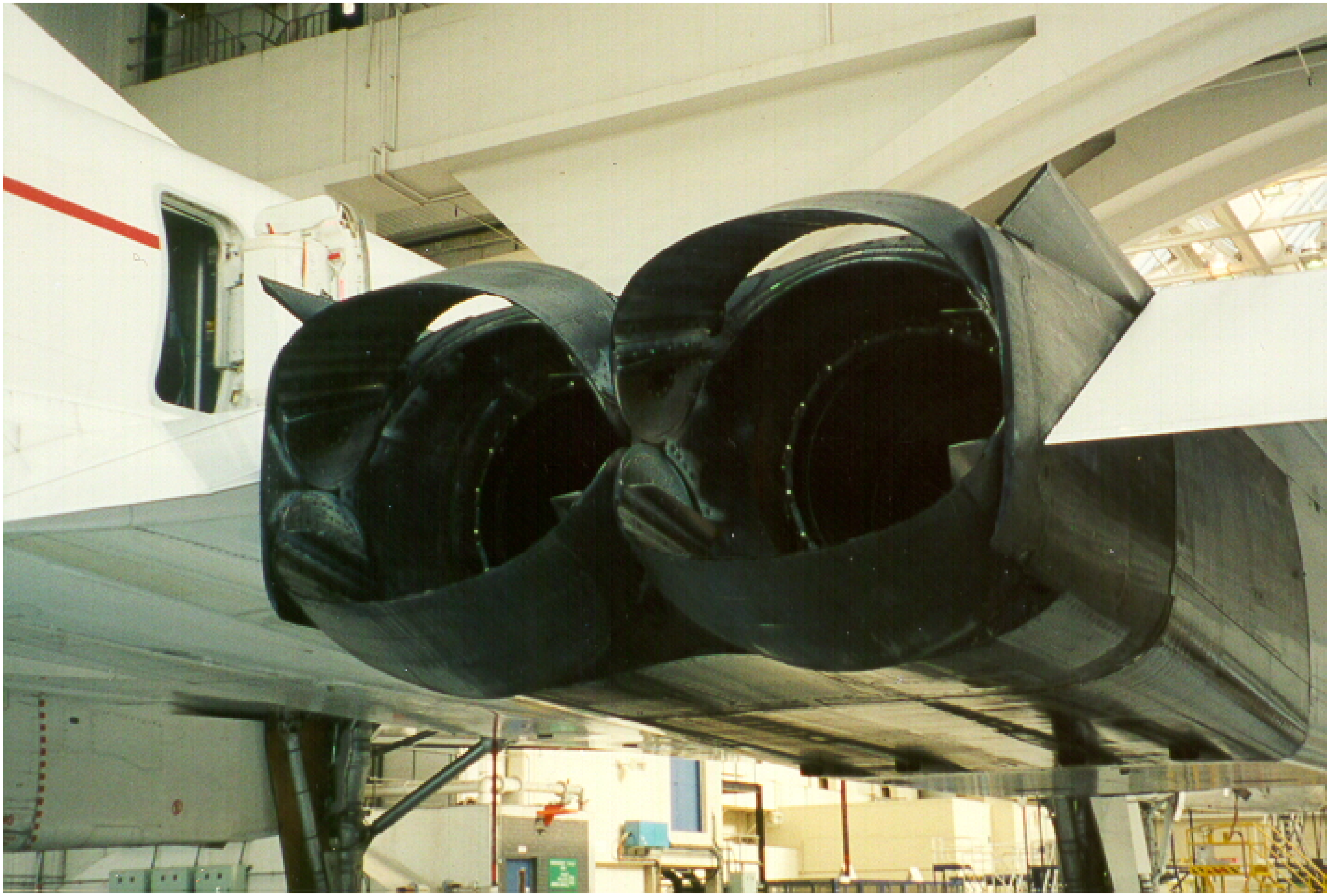
Disadvantages:

- Multiple variable geometry devices (inlet, engine, nozzle)
- Numerous aero/mechanical design challenges
- Possible higher maintenance
- Unproven field experience (reliability questions)

Exhaust System Considerations

- **Stage 4 noise requirements**
- **Aircraft thrust requirements (high Cfg)**
- **High temperature environment**

The Concorde Variable Area, Con-di, Thrust Reversing Nozzle



Background

•Rolls-Royce has 27 years experience in Mach 2 commercial flight (Concorde/Olympus)

•Rolls-Royce has studied SSBJ propulsion requirements for over a decade with airframe companies worldwide

•AADC has more than a decade experience in High Mach propulsion demonstrators

• AADC has more than two decades experience in high temperature technologies

Olympus Engine Experience

Rolls-Royce Olympus 593 Operational Data:

Total engine flying hours = 928,000

Total engine flying hours above M1.0 = 595,000

Total engine flying hours above M2.0 = 473,000

AADC Technology Programs

- Quiet Supersonic Platform (QSP)

- Ultra-Efficient Engine Technology (UEET):
  - Regional jets
  - Access to space

- Long Range Strike (LRS, Mach 2-4)

- JETEC (Mach 3.5 demonstrator engine)

- IHPTET (Technology demonstrators)

- VAATE (Performance/Cost Capabilities)

QSP Program Objectives (Precursor to IIPSS)

Fly Fast: Mach 2.4 (Concorde: Mach 2.0)

Fly Quiet: Overland (Concorde: restricted to overwater)

Fly Far: 6000 miles (Concorde: ~3000 miles)

QSP Performance Goals

	QSP	Concorde
Aircraft TOGW	100,000 lbf	400,000 lbf
Cruise Mach Number	2.4	2.0
Range	6,000 nm	3,150 nm
Sonic Boom Ground Signature	0.3 lb/sq ft	~2.5 lb/sq.ft.
Lift to Drag Ratio	11	7.4
Payload Mass Fraction	20%	6%
Thrust SFC (dry)	1.05 lb/lb-hr 0.95 (M = 2)	1.19 lb/lb-hr
Engine Thrust to Weight Ratio	7.5	4.0 (withA/B)
Aircraft Weight Breakdown		
Fuel	40%	50%
Payload	20%	6%
Empty	40%	44%

Summary

- Technologies identified in IIPSS program applicable to SSBJ, commercial transports and military applications for Mach 2 flight

- Possible markets include package and freight distribution, in addition to passenger travel

- Sonic boom mitigation is the enabling technology to make commercial supersonic flight economically feasible (permits both overland and overwater operations)

- AADC combines its high temperature technology with Rolls-Royce's Concorde experience and lead position in SSBJ propulsion studies for the next generation of commercial/military supersonic flight