FAA Engine Focus Panel

LW Dunbar
GEAE
November 13, 2003

imagination at work

Notional SSBJ Propulsion Requirements

- *Cruise @ Mach 1.5 to 2.0, altitude 50K to 70K*
  - *Overland Supersonic Operation Desired*
- *Range: 4000 to 5000 nmi*
- *Minimum of 2 engines*
- *Noise Stage 4 with margin*
- *Nacelle geometry consistent with low boom*
- *> 2000 hrs supersonic cruise life between overhauls*
- *Emissions at least equivalent to current commercial production*
- *Thrust reverser likely required*
- *Earliest availability: 2010 introduction to service*

Supersonic Biz Jet CTQ's

- *Noise*
  - *fan pressure ratio*
  - *advanced nozzle system*
- *Emissions*
  - *turbine temperature (T41)*
  - *combustor design*
- *Transonic Thrust*
- *Range*
  - *SFC*
  - *weight*
  - *drag*
  - *installation*
- *Life*
  - *compressor exit temp (T3)*
  - *turbine inlet temp (T41)*

Engine Sonic Boom Impact

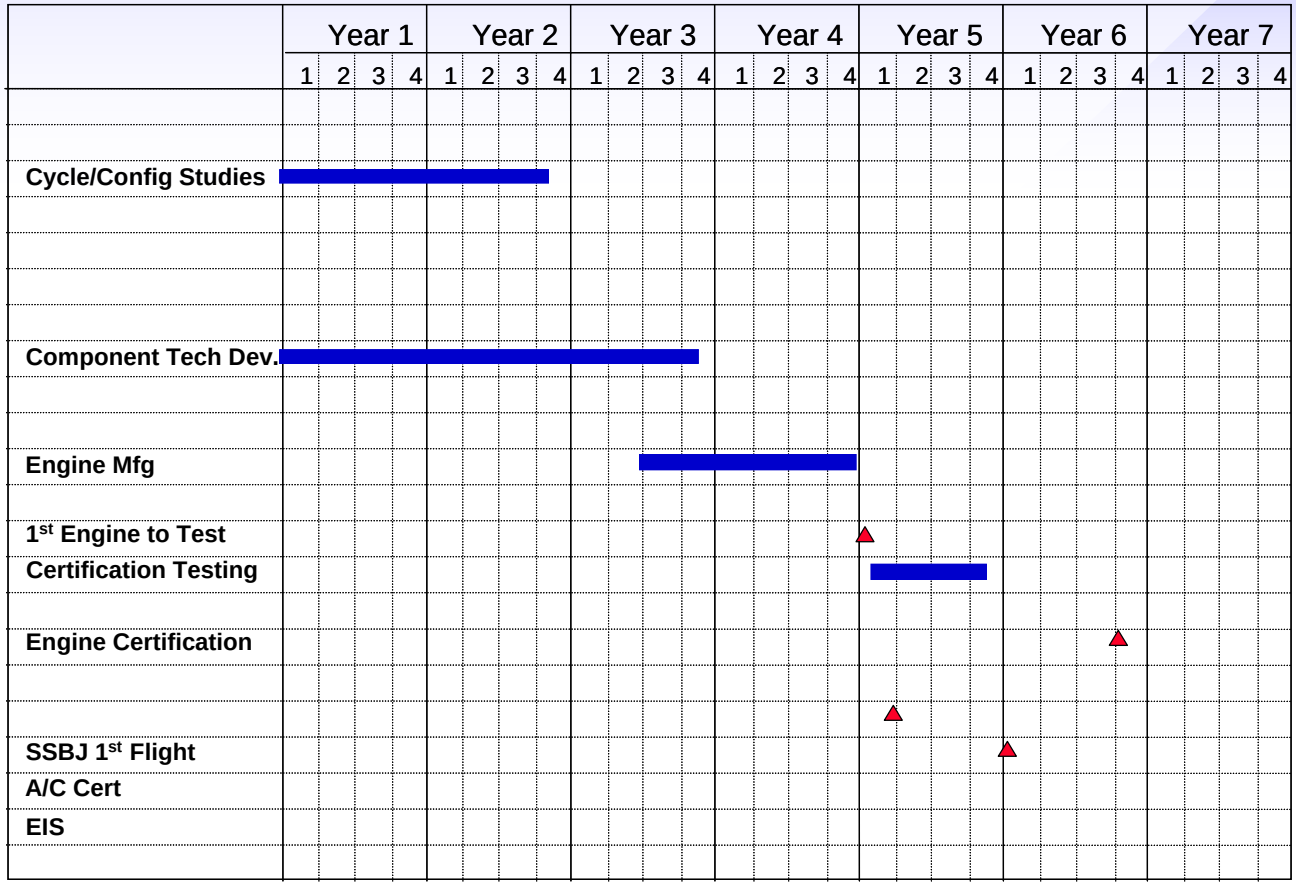
- *Diameter*
- *Vehicle Area Distribution*
- *Engine Placement*
- *Flow Area Modulation*

Certification & Development

GEAE has full confidence that our SSBJ engine will achieve certification once the decision is made to proceed. As with any new concept, there are areas which are considered more critical and will require a joint airframe/engine risk abatement/mitigation plan to ensure certification is achieved. These areas include:

- *Noise Acceptance*
- *Emissions*
- Sonic Boom
- *Rotor Burst*
- *Engine Spacing*
- *Supersonic Aircraft Rules*

Development schedule for FAR 33 Cert?



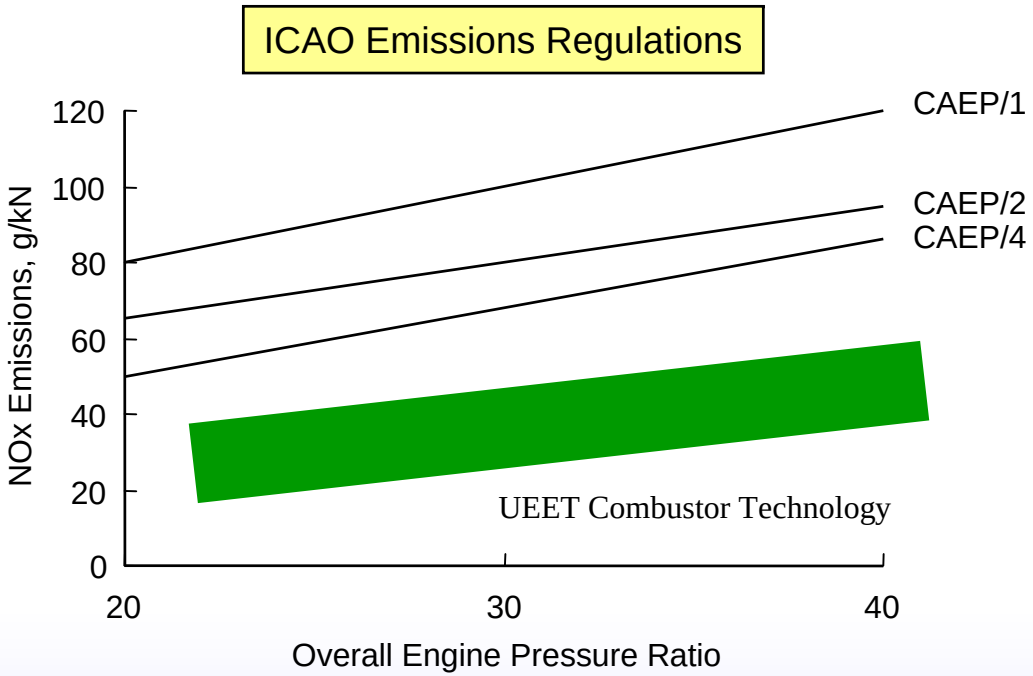
Supersonic engine could be certified within ~5 –6 years

Technology Demonstrator Engine

- *Linked to Advanced Engine demonstrator plan*
  - *Technologies & Configuration Synergistic with a number of potential products*
- *Core test as early as 2007*
- *SLS turbofan test potentially in 2008*
- *Engine available for initial flight tests 2009*
  - *Altitude test?*

Emissions Goals for SSBJ Engines

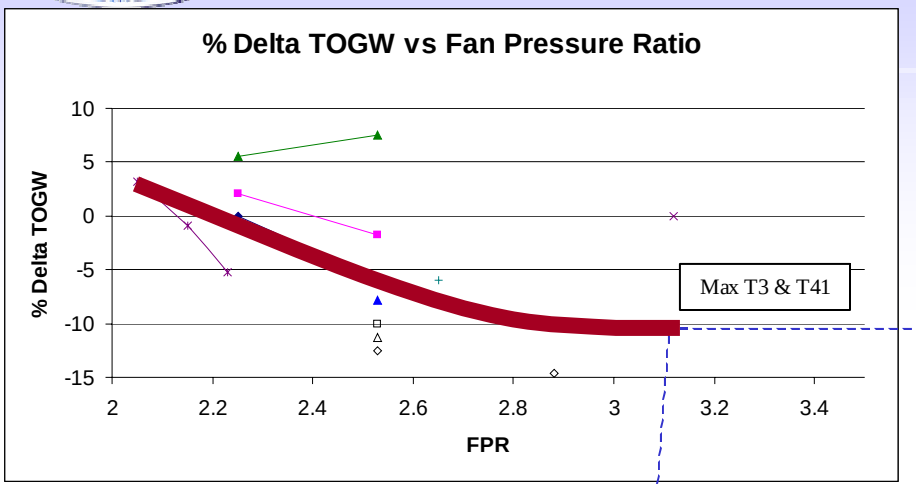
- No Firm Requirements Yet
- Will be Using Latest Low Emissions Combustor for This Program
- Selection of Overall Cycle PR Will Influence NOx

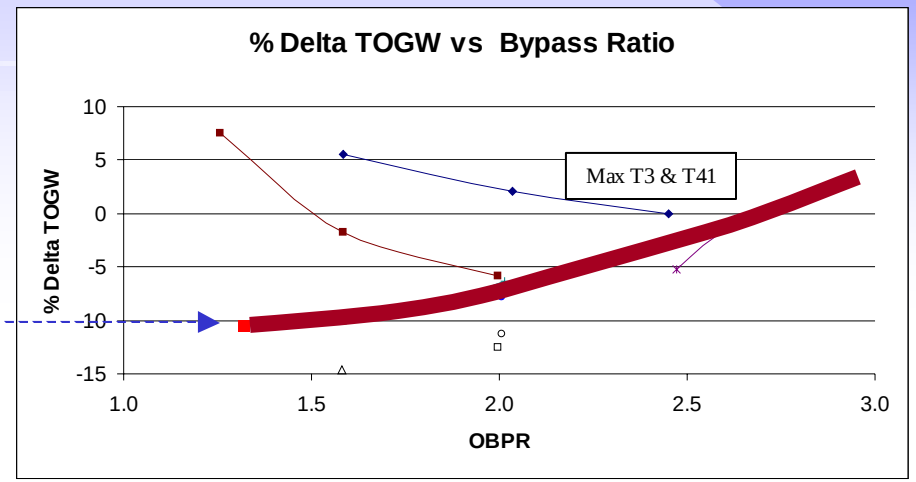


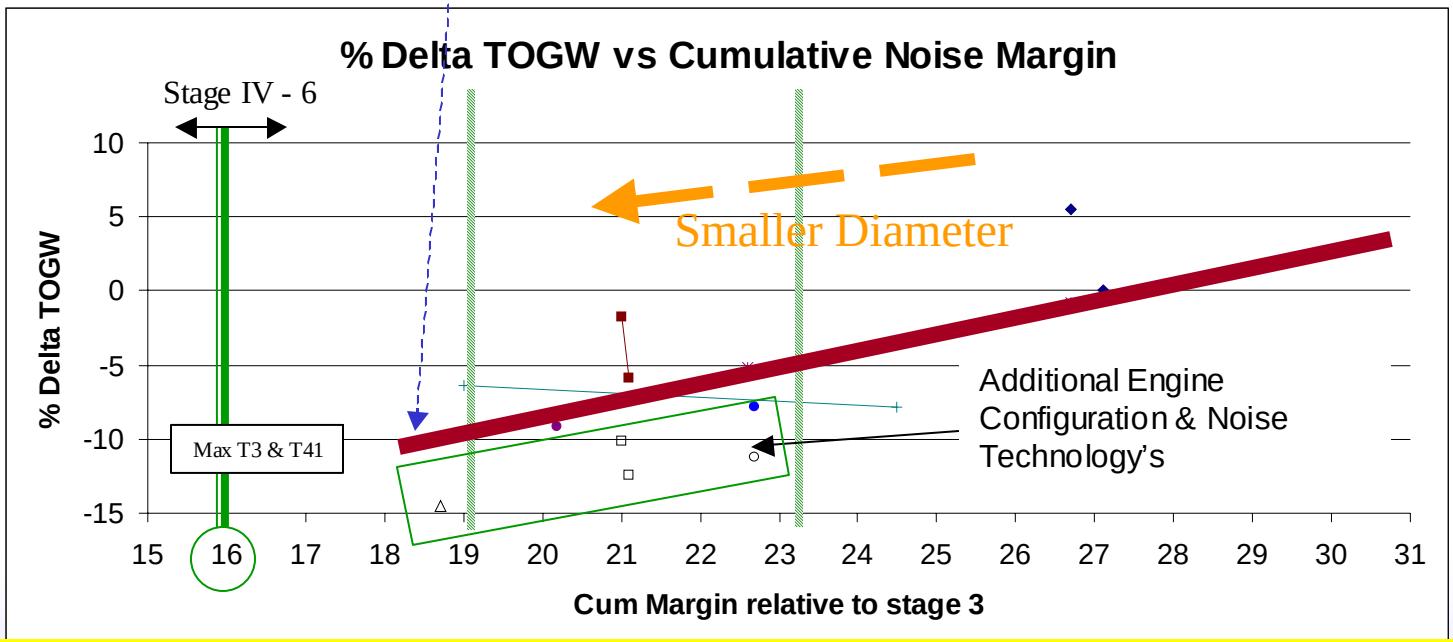
- CAEP = Committee on Aviation Environmental Protection
- CAEP/4 from 1998 Meeting

Standards for Engines with FN >6K	
Species	Grams/Cycle/kN Thrust
HC	19.6
CO	118.0
Smoke Number:	$83.6 * FN^{-0.274}$

Cycle Impact on Noise and Vehicle Size







Vehicle Performance Favors Highest Noise Limited Specific Thrust

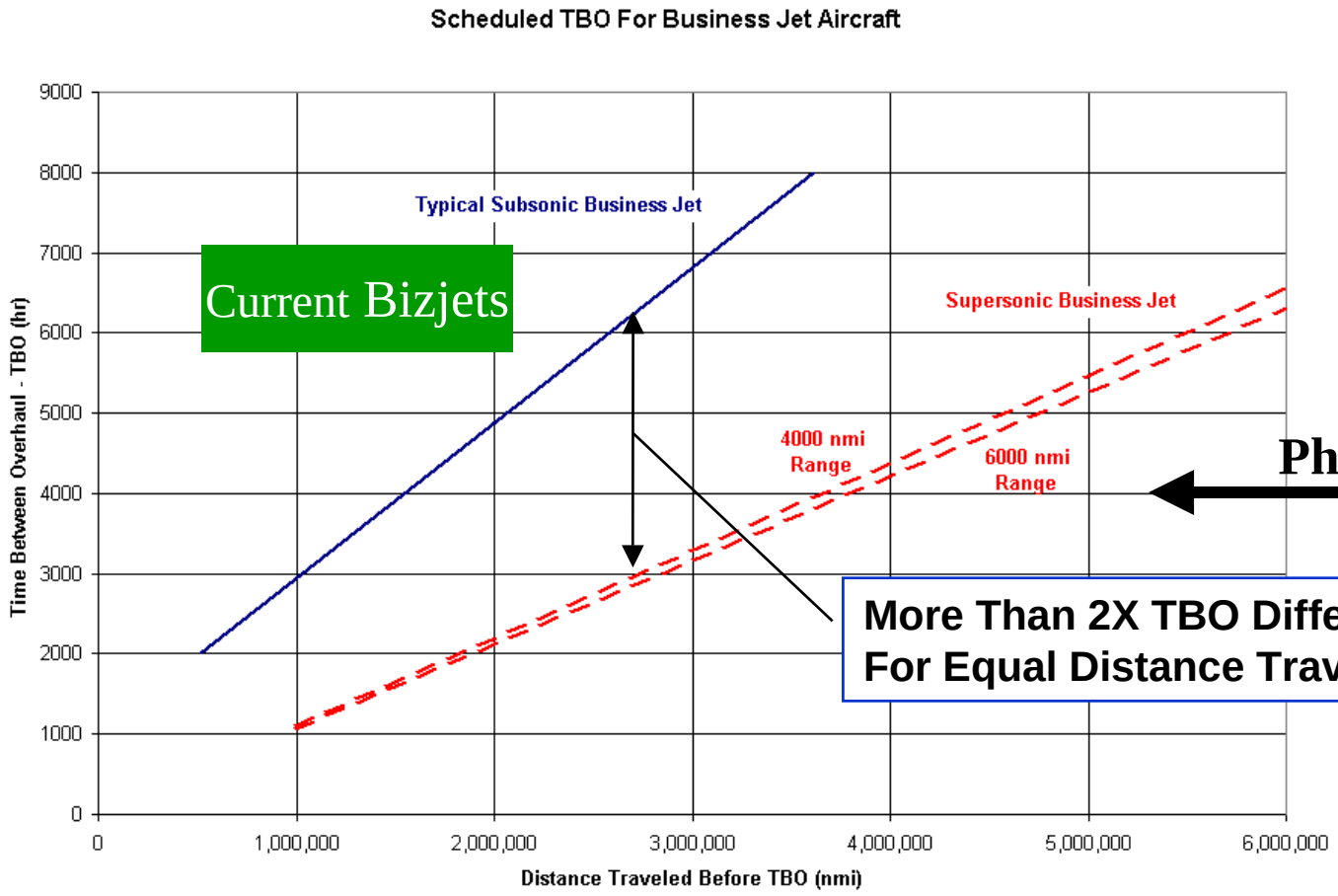
Is it feasible to be capable of attaining Stage 4 cumulative noise characteristics with Margin?

YES – But it requires a complete system solution and may require a Staged Implementation Depending on EIS.

- *Propulsion System Controls Sideline*
- *Combination of Propulsion System, Airframe Installation, and Flightpath Controls Cutback*
- *Mainly Airframe Noise and Engine Installation Controls Approach*

Propulsion System, Airframe Installation, Flightpath, and Airframe Noise All Contribute to the Cumulative Margin and Achieving Stage 4 !

Reliability
SSBJ TBO Requirement?



GEAE accepts the goal to achieve the 4,000 hour TBO.

Extended Time-at-Temperature

- Recognized as critical life issue
  - addressed in QSP, LRSA and SSBJ studies
- Engine design based on Mechanical Design inputs to achieve HPT disk and blade lives
  - T41 & T3 levels
    - Special attention required to mitigate high T3's
  - HPT Configuration has a significant Role
- Supersonic overland mission will increase Hot time

Summary

- *Sonic Boom Solution May be Complementary to Other Requirements*
  - *Performance*
  - *Acoustics, etc.*
- *Propulsion System can Be designed for a successful SSBJ*
  - *Durability and Market Robustness need Additional work*
  - *Emissions requirements need to be Characterized*
  - *System Noise solution needs further Demonstration*
- *Barrier issues require integrated system solutions*
  - *Acoustics, Emissions and Sonic Boom require Demonstration*
  - *Simulated Product Environment*
- *Configuration Synergistic with Advanced Military Systems*
  - *Technologies have a wide range of applicability*
  - *Demo Vehicle Should have wide support*
  - *We are very interested*