Supersonic Noise and Emissions Research

Presented To: REDAC E&E Subcommittee

By: Don Scata & Ralph Iovinelli

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Federal Aviation Administration

Supersonic Noise Research

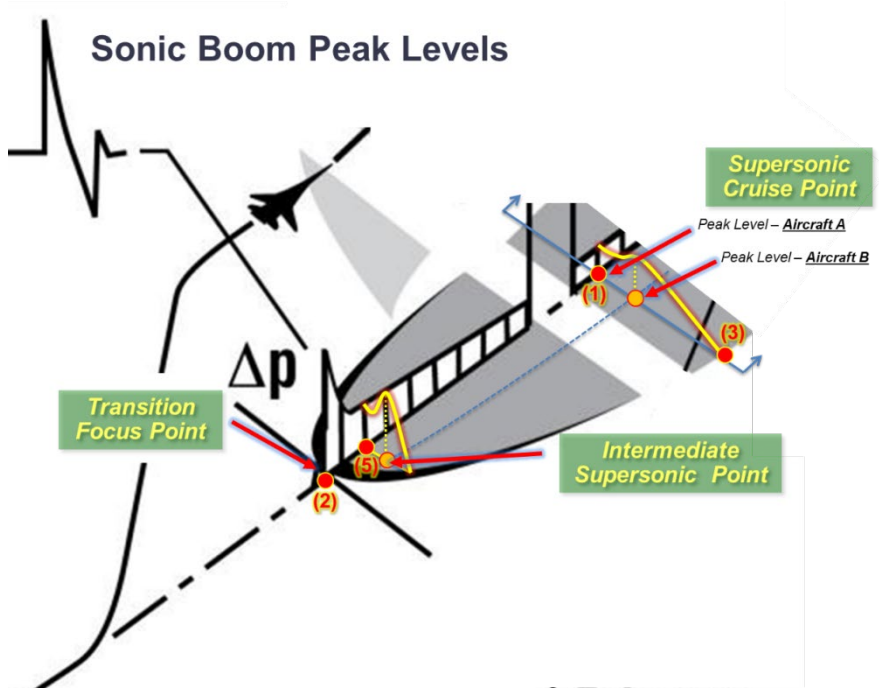
ASCENT P#41- Identification of Noise Acceptance Onset for Noise Certification Standards of Supersonic Airplanes

Status:

Completion delay due to COVID until Dec'20 with final report.

Recent achievement:

- Support of WG-1 development of en-route, low boom certification standard for SST and other noise impacts at ICAO-CAEP.
- Established Reference Day standard for certification (ISO 5878:1982 /Add 1:1983, with extension humidity model, together with ICAO 7488/3.



ASCENT P#57- En Route Noise Certification of Supersonic Airplanes to Support ICAO-CAEP

Status:

- FAA awarded August 2020 and to be completed in late ‘21/early ‘22.

Objective:

- Continue support of WG-1 on development of en-route, low boom a certification standard for supersonic airplanes, plus other ICAO-CAEP impact activities.
- Understand and predict secondary sonic boom
- Explore existing NASA/FAA capabilities

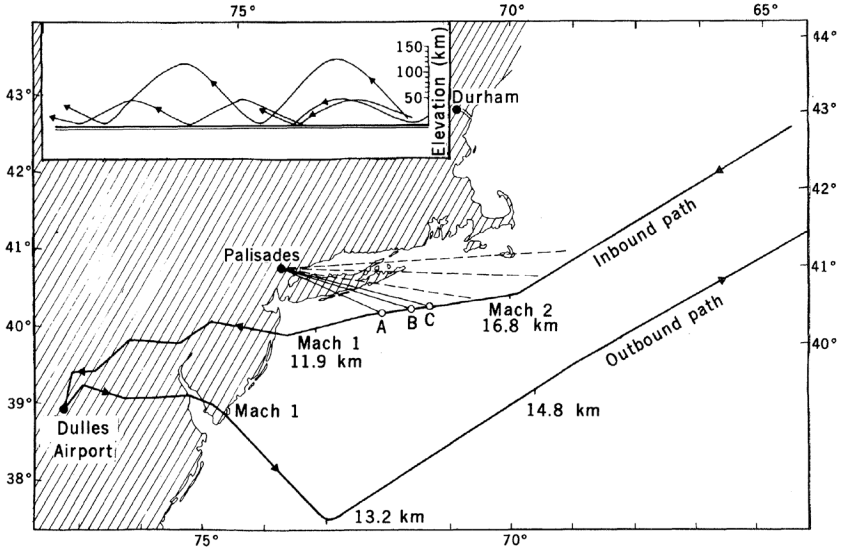


Fig. 2. Map showing the inbound and outbound flight paths of the Concorde supersonic transport. Elevation and speed are marked on the tracks. Points A, B, and C are average source locations for the first three signals received at Palisades. Although both inbound and outbound signals are recorded at Durham, instrumentation for directional determinations has not been completed at this site. The inset shows a schematic ray tracing indicating ray paths through the stratosphere (about 40 to 50 km) and the thermosphere (100 to 130 km).

ASCENT P#59 - Jet Noise Modeling to Support Low Noise Supersonic Aircraft Technology Development

ANNOUNCEMENT:

Project Title: Jet Noise Modeling to Support Low Noise Supersonic Aircraft Technology Development

Nominal Funding Level: $200,000 per year

Period of Performance: 3 years

Project Description:

The goal of this new research project is to work in close collaboration with industry, NASA, and academia in order to leverage and further previous ASCENT work by Georgia Tech and MIT on Projects 10 and 47 respectively, to identify novel methods to reduce jet noise from Civil Supersonic Aircraft engines. Gas turbines for supersonic aircraft need to have a relatively small engine diameter to avoid large fuel burn penalties during supersonic cruise. To have sufficient thrust, the jet exit velocity needs to be relatively large (as compared to subsonic jet engines) resulting in substantial noise from the jet exhaust.

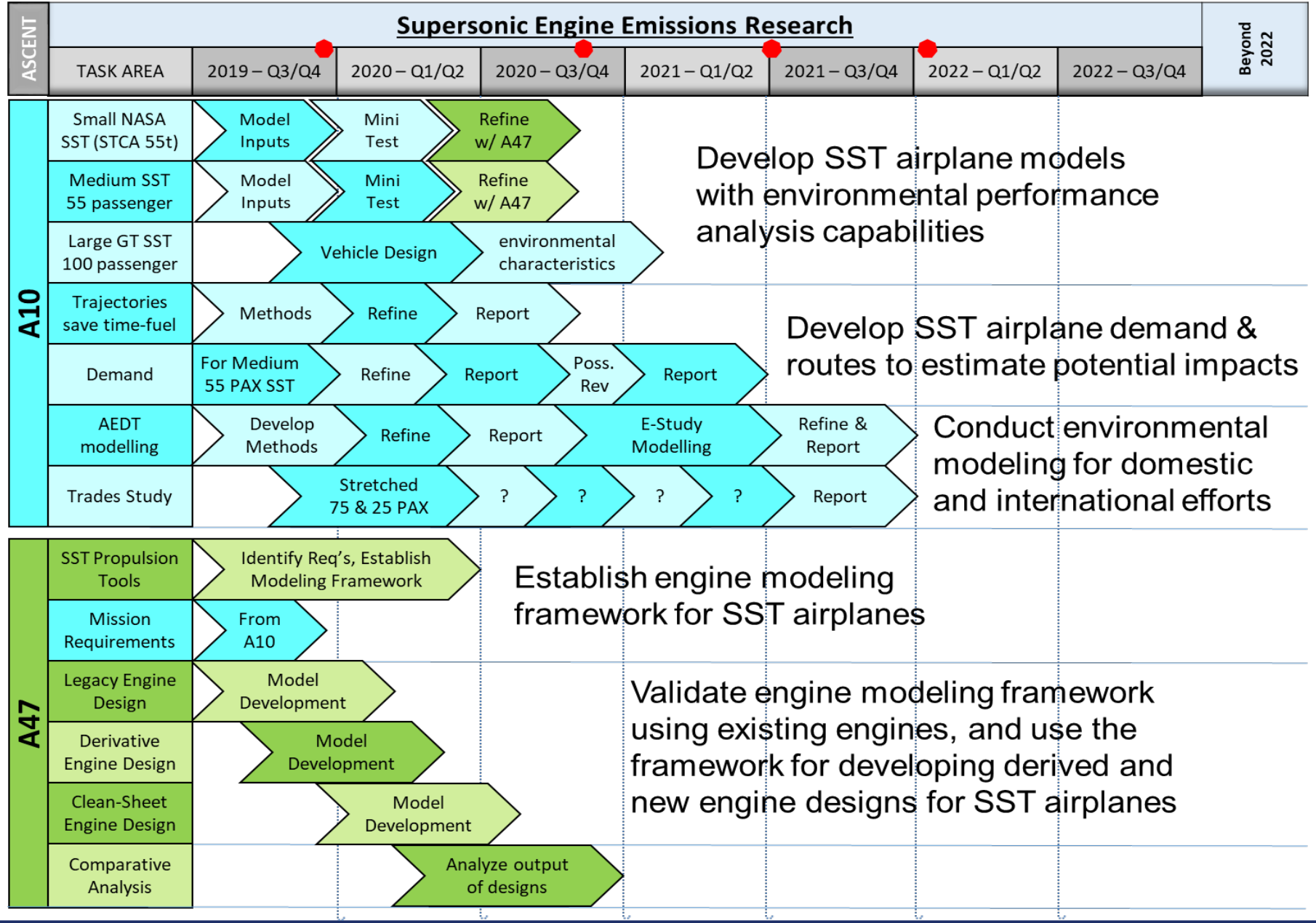
Awarded grants in April 2020 to:

- GaTech
- Penn State
- Stanford U
- U of Illinois U-C

Supersonic Emissions Research

Supersonic Engine Emissions Research – Policy, CAEP, Tools, Impacts

- With the proposed supersonic aircraft, development of:
  1. Airplane models with environmental performance capabilities; and;
  2. Demand routes to estimate potential impacts are needed.
- Environmental modeling is needed for domestic and international efforts. ASCENT 10 addresses these needs not only for emissions but also for noise.
- Proposed engine designs for the new SST use existing cores. ASCENT 47 investigates the emissions benefits that may be realized if a clean sheet engine design is adopted from a modeling perspective.



Collaborator: NASA

These proposed timelines are from the original proposals. This research was affected by the delayed funding cycle, so these items will slide to the right. Updates are forthcoming…

Supersonic Engine Emissions Research

Deliverables:

- ASCENT 10: SST Modeling Tools and Demand Scenarios
- ASCENT 47: Emissions Impacts of clean sheet supersonic engine design
- ASCENT 74 (new): Emissions performance of a novel lean pre-mixed combustor for a SST engine

Success Criteria:

- Realistic aircraft and engine designs to estimate environmental impacts
- Forecast fleet comparing well with actual future fleet

Future Work:

- Inform future SST engine emissions standards
- Emissions predictions methodologies for full flight gaseous and particle emissions

Summary

- **AEE has active supersonic research projects for both noise and emissions**
  - Supports domestic and international policy/rulemaking
  - Investigates low boom concept
  - Investigates modern engine designs
  - Provides insight into environmental effects of modern civil supersonic marketplace
- **Collaborations with NASA**

Don Scata & Ralph Iovinelli
Federal Aviation Administration
Office of Environment and Energy (AEE)
Emails: donald.scata@faa.gov
ralph.iovinelli@faa.gov