LARCSEA

NIAC Phase I, Step B Proposal

Low-Altitude Re-Configuring Super-Efficient Aircraft

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April 1, 2015

NIAC Overview

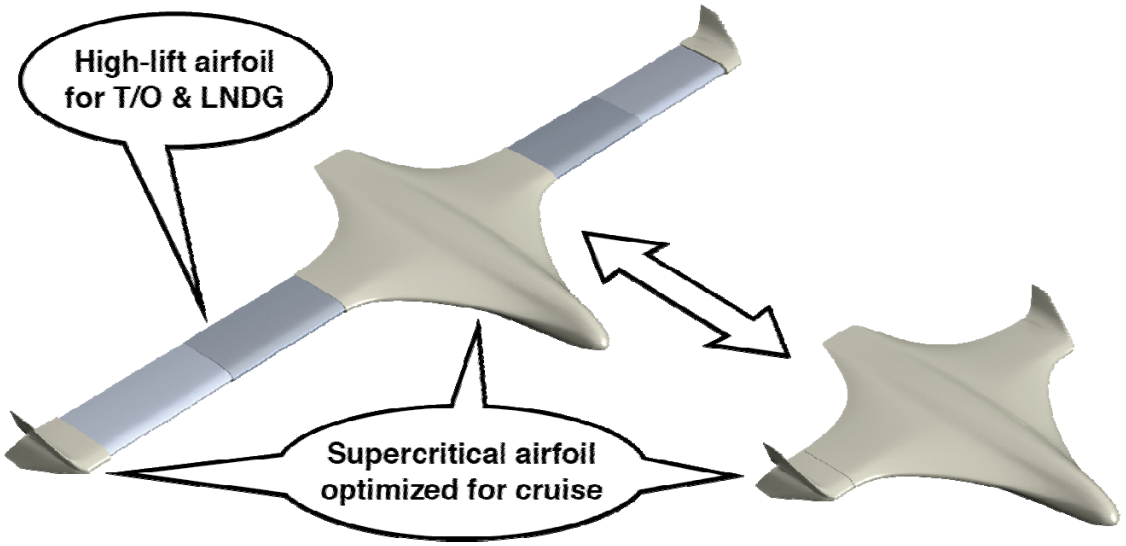
NASA Innovative Advanced Concepts (NIAC)

- **Early studies** of visionary aerospace **architecture**, **mission**, and **systems** concepts; awarded by NASA HQ
- $100K total award for phase I, then phase II and beyond have more
- Open to: All categories of US organizations, and non-US partner organizations
- Key Dates:
  - Release: OCT 2014
  - Step A proposal: NOV 2014
  - Step A announcement: DEC 2014
  - Step B proposal: JAN 2015 (invitation only)
  - Selection Announcement: JUN 2015
  - Award Start Date: JUL 2015, period of 9 months
- LaRC process:
  - Historically ~2/15 selected from LaRC for step B
  - Committee established to decrease out-of-scope proposals *(Directorate and LaRC-HQ Reps)*
  - Down-select prior to step A, shark-tank presentation
  - Substantial vetting, and **support** prior to step A submittal
  - Now 2/5 LaRC proposals selected for step B, then resources open from LaRC to support step B proposal

LARCSEA Overview

Systems Concept

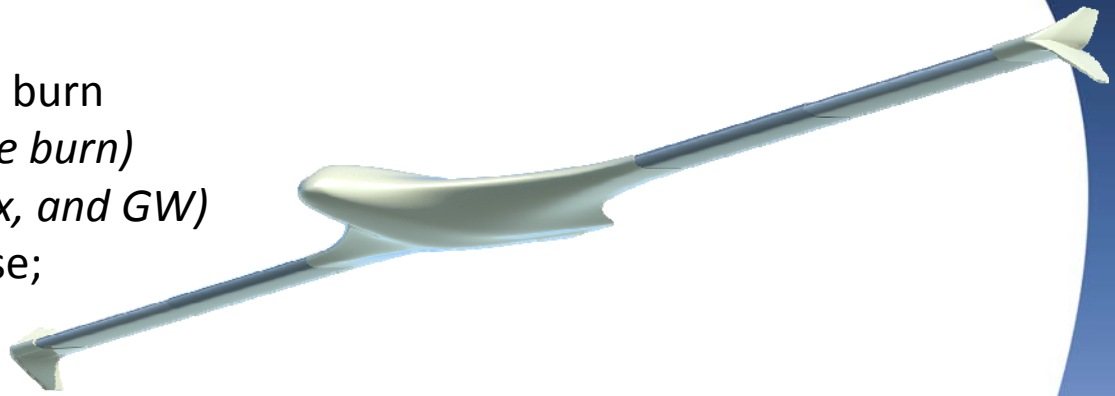
- Low-altitude cruise (15Kft – 20Kft) to realize environmental and performance benefits
- Aerodynamically actuated radical shape-change
- Tubeless, tail-less fuselage
- Potential configuration uses a telescoping-wing powered by active winglets
- Address projected travel increase by year 2031 *(2x traffic volume of 2011)*



LARCSEA Overview

Benefits of Profile

- Reduced climb, reduction in fuel burn
  (typically climb burn is ~ 3x cruise burn)
- Environmental benefits *(less NOx, and GW)*
- Smaller required engines in cruise;
  may need 3 or more engines
  to realize any size reduction
  (T/O engine out requirements)



- Fuselage pressure differential is only 1/3 of conventional altitudes
- Faster speed of sound at lower altitude
- Less wind at lower altitude
- Split winglets enable redundancy, can tailor tip vortex, can potentially eliminate traditional ailerons and spoilers, can create yaw and drag on approach
- Active controls likely required, can also be used for stability margin with a neutrally-stable design

LARCSEA Performance Potential

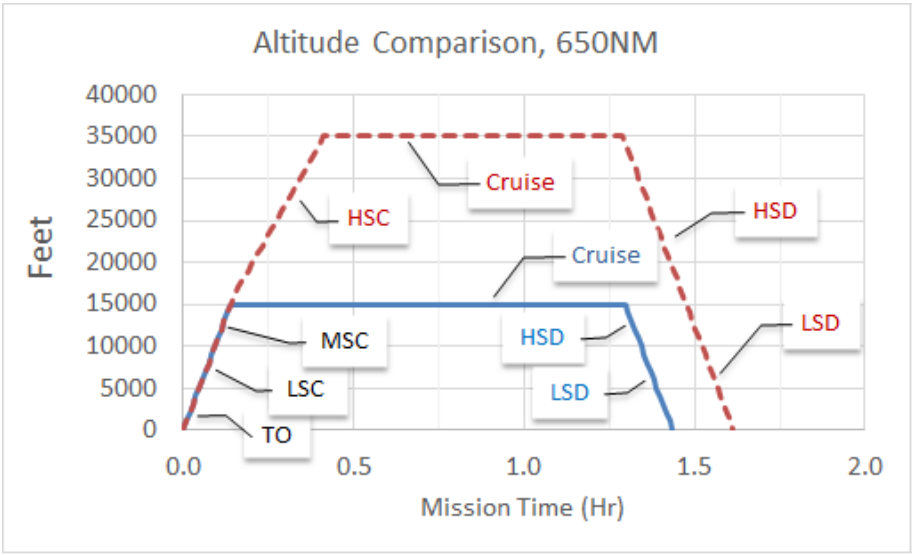
Assumptions

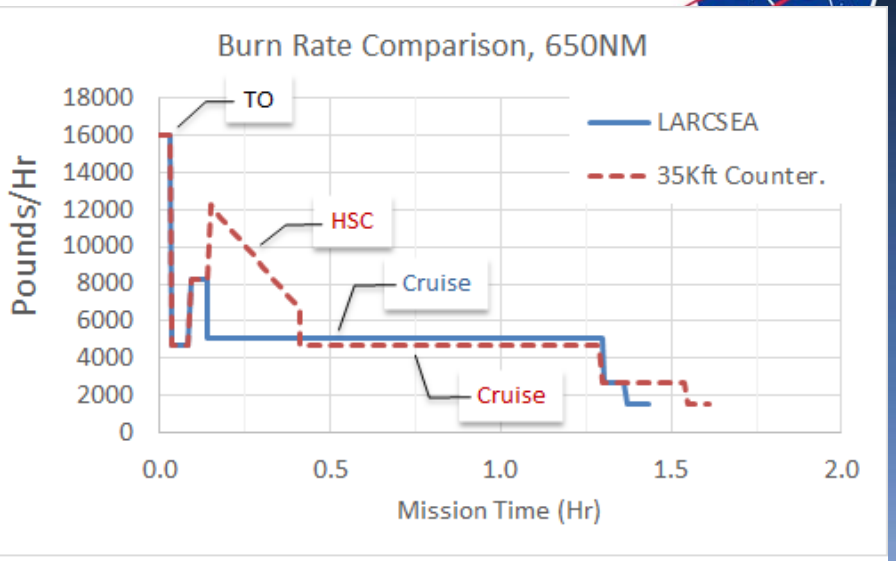
1. Comparison aircraft exists with traditional 35Kft cruise
2. Comparable L/D as comparison aircraft *(wetted aspect ratio)*
3. Comparable weight as comparison aircraft

Potential Benefits of LARCSEA Profile

- 1.4x fuel efficiency improvement
- 11% reduction in flight time
- 1.5x reduction in NOx impact
- 1.5x to 2.1x reduction in global warming effect

LARCSEA Performance Potential





Legend:

TO - Takeoff (0-3Kft)

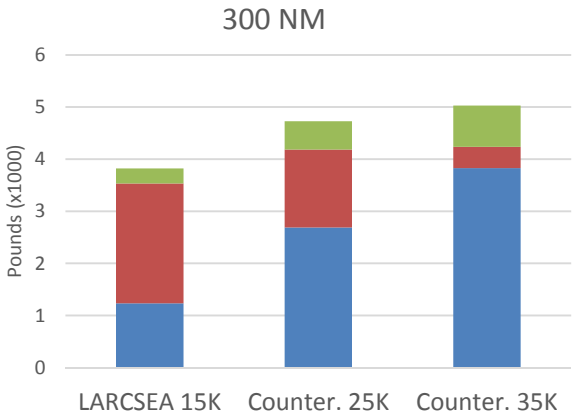
LSC - Low speed climb (3Kft-10Kft)

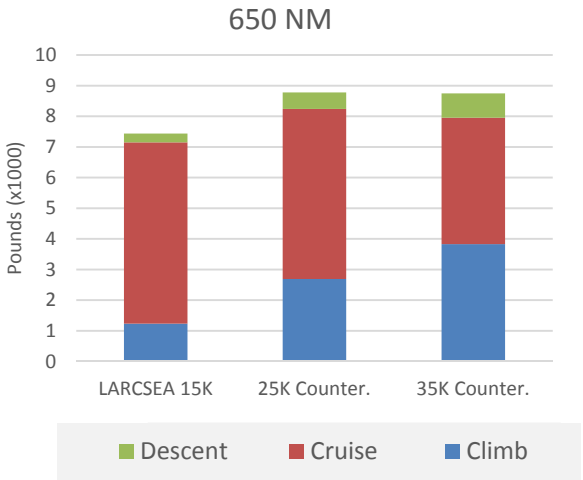
MSC - Medium speed climb (10Kft-16Kft)

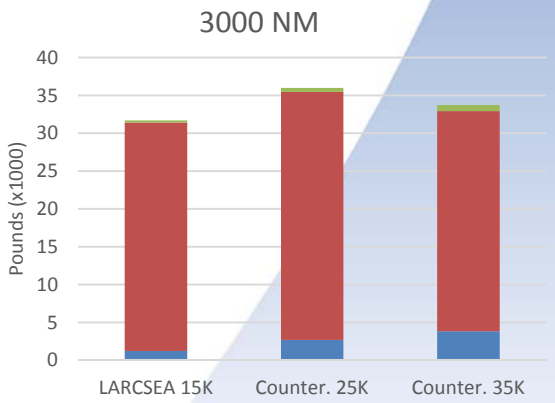
HSC - High speed climb (16Kft-35Kft)

HSD - High speed descent (35Kft-10Kft)

LSD - Low speed descent (10Kft-0)







LARCSEA Challenges

- Radical shape-change mechanism: robust, reliable, at acceptable weight
  - Stuttgart FS-29
  - Morphing studies
- Payload capacity
  - More design options, but still volume limited
- Controllability and operability
  - Redundant processors, dual-boost actuators, wiring etc.
  - Reliance on active-controls could become more commonplace in future decades (circa 2040)
- Weather
  - Less clear-air turbulence, “sweet-spot” between 15Kft and 20Kft
  - Convective turbulence, icing
    - No worse for high-intensity frontal systems
    - Low-medium intensity weather systems, cursory look: altitude dependent, options usually exist between 12Kft to 20Kft
- Proposed phase I effort will be a systems-level analysis to systematically address the challenges and test assumptions