UTC Aerospace Systems

Integrated Propulsion System (IPS)

THRUST REVERSER TECHNOLOGY DEMONSTRATOR

Presenter: Louis Jutras
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CONTINUOUS LOWER ENERGY, EMISSIONS AND NOISE (CLEEN II)

CLEEN II Consortium Public Session

ecoips™

OUTLINE

UTC/UTC Aerospace Systems company overview

Elevator Speech

Technologies

Project Schedule

Year 1 Achievements

Year 2 Plans

Summary

UNITED TECHNOLOGIES

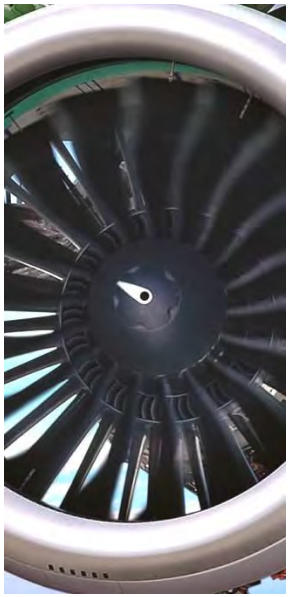
United Technologies
Climate | Controls | Security

OTIS

Pratt & Whitney
Dependable Engines

UTC Aerospace Systems






Leading provider of high technology systems for the commercial building and aerospace industries

Employs approximately 220,000 people in more than 4,000 locations

Located in approximately 70 countries around the world

2015 net sales of $56B

UTC AEROSPACE SYSTEMS

Business Units

Aerostructures

ISR & Space Systems

Landing Systems

Sensors & Integrated Systems

Interiors, Actuation & Propeller Systems

Environmental Control Systems & Electric Systems

UTAS AEROSTRUCTURES

Key Products and Systems

Nacelle systems

Pylons and fairings

Tailcones

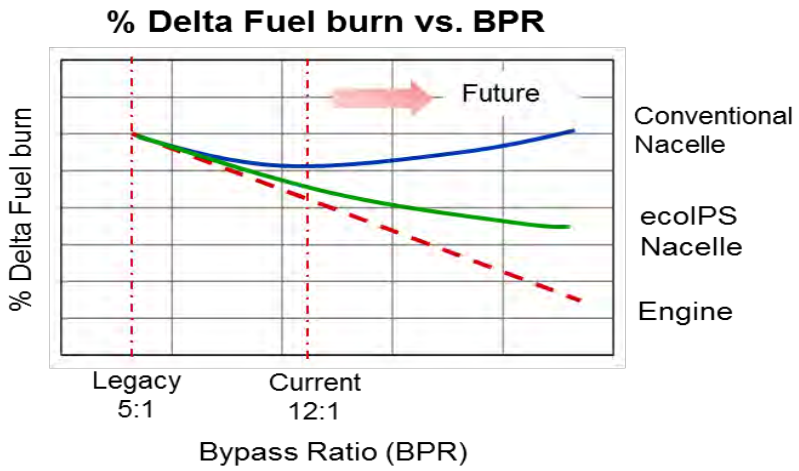
Key Platforms

UTC Aerospace Systems – Aerostructures is a leading independent supplier and integrator of nacelles and pylons, offering complete life cycle design/build/support for large commercial and regional jet customers around the world

ELEVATOR SPEECH

Case for action

UHBR: Fuel burn benefit



Weight and drag of increasingly larger conventional nacelle offsets performance benefit of lower fan pressure ratio

Inlet/fan cowl (Fanlet)

Variable area fan nozzle

Novel thrust reverser architecture (FAA CLEEN II demonstrator)

- ✓ Short, clean fan duct
- ✓ Hybrid laminar flow
- ✓ Tailored acoustics
- ✓ Advanced manufacturing
- ✓ Innovative materials




TECHNOLOGIES

CLEEN II demonstrator – key to mature technologies

Technology Name	Goal Impact	Benefits and Application
Short, integrated fan duct thrust reverser	Fuel burn	~1.0% reduction. Demo designed for 25,000-40,000 lb thrust-class engines with expected entry into service by 2025.
Advanced acoustics	Noise	~2.5 EPNdB reduction. (to offset short fan duct)

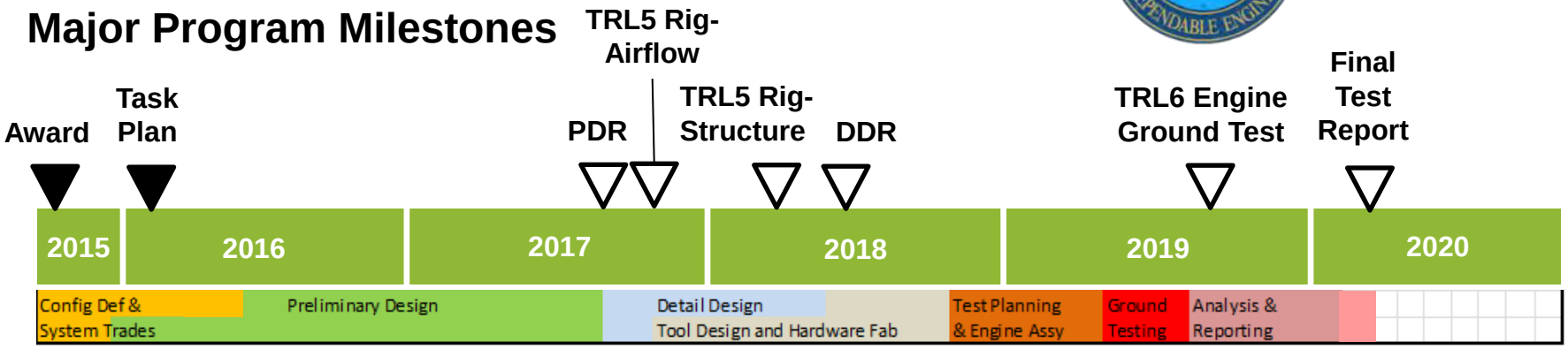
Legacy Thrust Reverser Fan Duct

CLEEN II Thrust Reverser Fan Duct

CLEEN II SCHEDULE

Thrust reverser demonstration on P&W GTF Engine

Major Program Milestones



Major Program Phases

YEAR 1 ACHIEVEMENTS

Shorter Thrust Reverser
then legacy designs

2012 – 2015 IRAD
30+ Short/Clean
Duct Configs.

2 Short/Clean
Duct Configs.

Demo
Config.
Down Select

Demo
Concept
Design

Demo Models
Stress, Aero,
Acoustics

Q1 | Q2 | Q3 | Q4

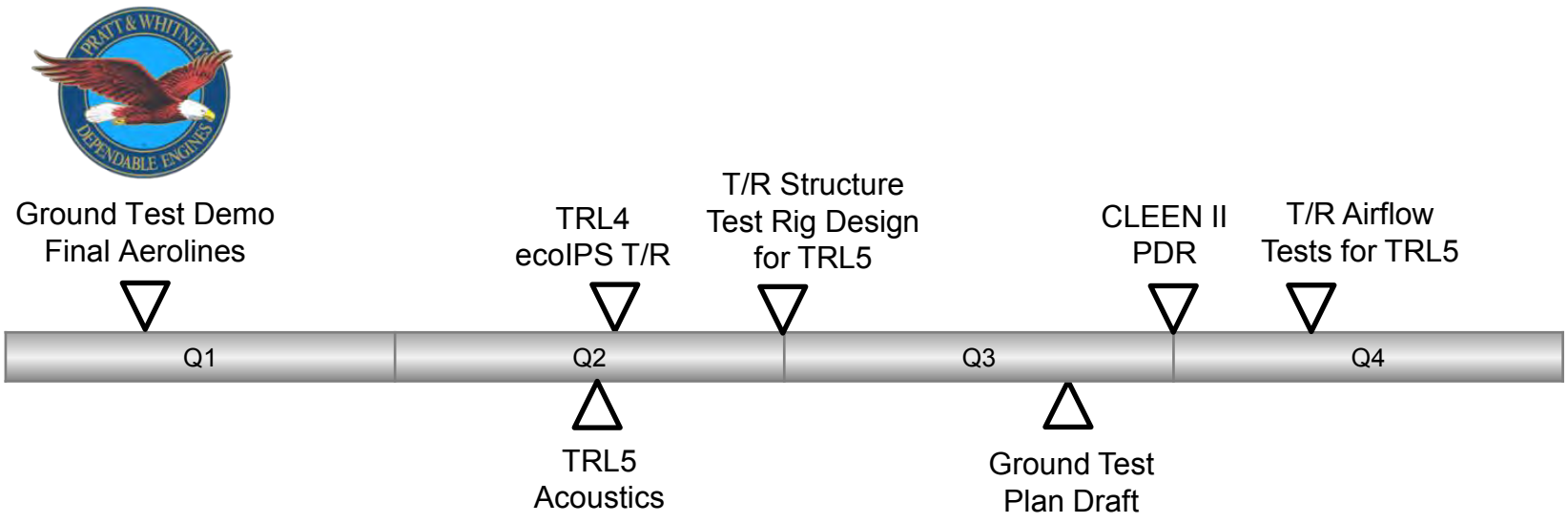
TRL4
Acoustics

T/R Test Rig
Design for TRL4

Test Engine/Pylon
Integration Workshop

2016

YEAR 2 PLANS



2017

PROJECT TECHNOLOGY

Short-Duct Thrust Reverser

Legacy
Fan Duct

CLEEN II Demo
Fan Duct

Anticipated Benefits:

~1% fuel burn reduction
~2.5 EPNdB noise reduction

Risks/Mitigation Plans:

Achievement of performance targets

- Integrated technology development plans
- Metrics and integration assessments
- Design options and rig testing

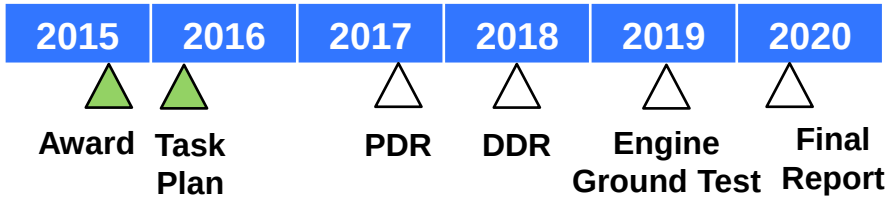
Objectives: *Demonstrate benefits of a reduced-drag, short fan duct integrated thrust reverser with improved acoustic treatments*

Work Statement: Continue the TRL advancement of integrated thrust reverser technologies via material & process development, rig tests, and engine ground test

Accomplishments:

Defined short-duct thrust reverser configuration
Performed preliminary performance analyses
Designed TRL4 structure validation rig
Achieved TRL4 for acoustic technologies

Schedule:



SUMMARY

Supports CLEEN II lower energy and noise initiatives

Integrated thrust reverser to be matured to TRL6

Maximizes efficiency of next generation ultra-high bypass ratio propulsion systems

Technologies applicable to next generation nacelles for Next Generation Single Aisle and New Midsize Airplane

Selected technologies applicable to performance insertion on current production programs