



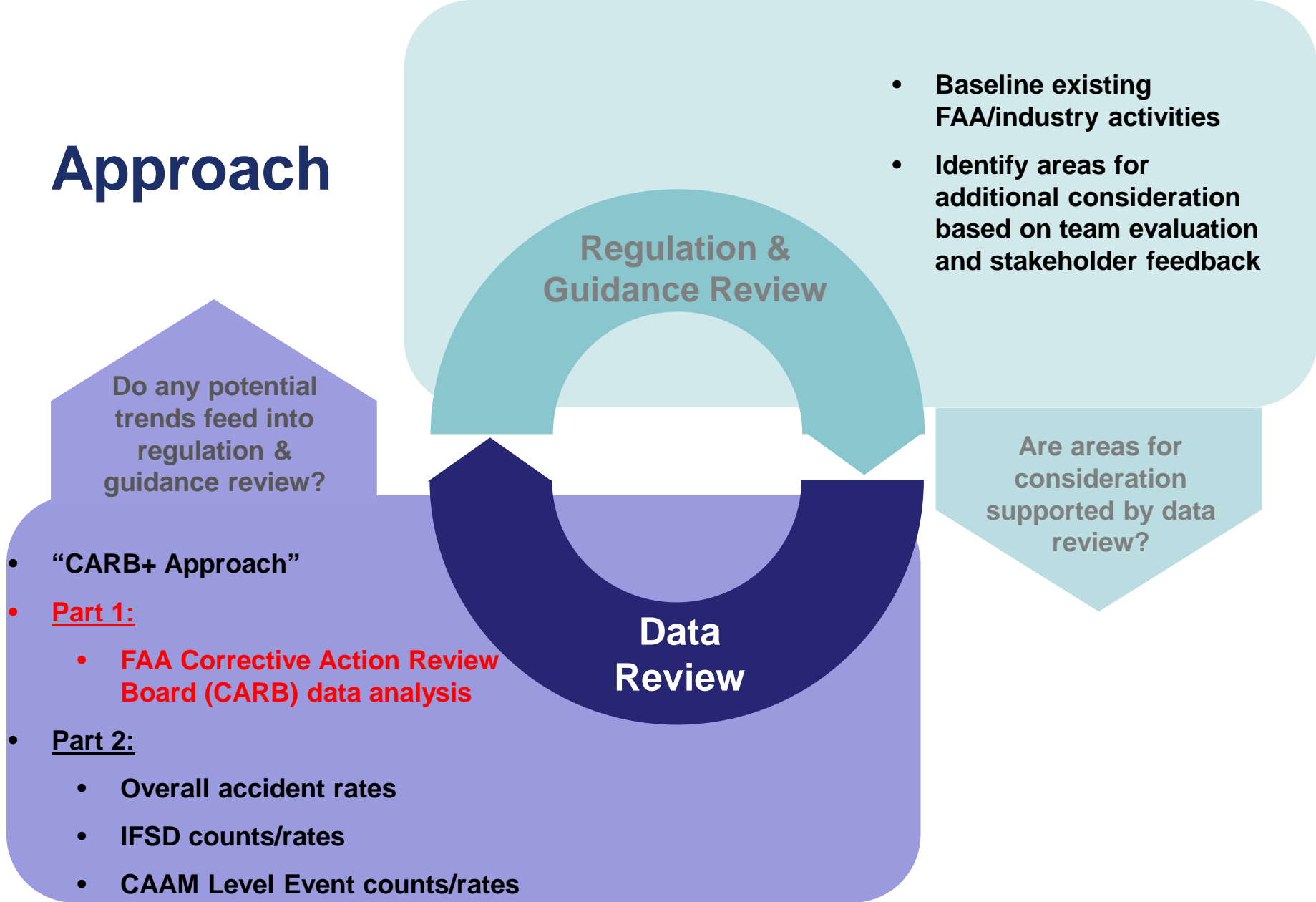
Federal Aviation  
Administration

# Engine & Airframe-Engine Integration Safety Team



**Presented to:** Stakeholder Outreach Telecon  
**By:** Engine & Airframe-Engine Integration Safety Team  
**Date:** June 25, 2019

# Approach



# FAA CARB Data Analysis - Process

- **EAEI team reviewed individual CARB packages (2013-2018) and extracted relevant event and causal information into database**
  - Limited to all Part 33 engine and Part 25 propulsion system items that the EAEI determined would be in-scope
- **FAA Subject Matter Experts reviewed the database for common themes, contributing factors, and trends**



# FAA CARB Data Analysis - Process

- **June 10<sup>th</sup>-14<sup>th</sup> face-to-face meeting (Burlington)**
  - Reviewed compiled list of team ~40 brainstorm items
  - Grouped & refined list of brainstorm items to help identify common themes and need for additional investigation
  - Team reviewed list line-by-line and verified supporting event data, causal factors, and rules/policy/guidance potential for improvement
  - Team then also reviewed additional sources of data to identify any other contributing factors that weren't already identified (see next slide)



# FAA CARB Data Analysis - Process

- **Additional Sources of Data Reviewed:**
  - NTSB Accident/Incident List 2013-2018
  - NTSB safety recs 2013-2018
  - FAA safety recs 2013-2018
  - In-process Transport and Engine & Propeller rules/policy/guidance (Including EACTB, CAPP, CATA, AIA activity)
  - Current and recent CAST Safety Enhancements
  - CAAM 3 Committee Lessons Learned Activity
  - SAFO's/UPN's
- **Team further refined table**
  - Initial prioritization based on CAAM Level Events and events where driving malfunction occurred (i.e. – uncontained)





## FAA CARB Data Analysis – Preliminary Areas for Discussion

- **Team identified ~20 contributing factors**
  - Range from specific technical issues to process issues to broad topics that may warrant further consideration by the industry
- **Currently in-process of reviewing and refining full list internally and developing initial recommendations**
- **The following slides contain a preliminary, in-process, sample of the team's efforts**
  - Not necessarily prioritized
- **Plan to continue to share this list as it evolves in coming meetings**



# FAA CARB Data Analysis – Preliminary Areas for Discussion

Ni Melt Defects

High Energy LLP Failures

Manufacturing Quality Escapes /  
Supplier Oversight

Ability to withstand fan blade out  
loads/damage (inlet/cowl/nozzle  
separation)

Maintenance Challenges with  
Aging and Transitioning Fleets

Engine Heath Condition  
Monitoring Systems

Key:



Contributing Factor



Potential Airframe/Engine Integration  
Contributing Factor



Team-identified area where there is no  
existing rule/policy/guidance activity that  
would address the issue





# FAA CARB Data Analysis – Preliminary Areas for Discussion

- Ni Melt Defects
- High Energy LLP Failures
- Manufacturing Quality Escapes / Supplier Oversight
- Ability to withstand fan blade out loads/damage (inlet/cowl/nozzle separation)
- Maintenance Challenges with Aging and Transitioning Fleets
- Engine Heath Condition Monitoring Systems

**Description:**  
 Significant uncontained disk failure event uncovered potential for sub-surface melt defects in Nickel

**Discussion:**  
 Subject of NTSB safety recs and FAA/industry collaboration to develop better inspection techniques

**Is this currently being worked?:**  
 Yes

**FAA Rule / Policy / Guidance Potential for Improvement?**  
 Yes – Policy/Guidance  
 Existing efforts will likely result in new policy and guidance material

**EAEI Team Recommendation:**  
 Continue Existing Efforts

- Gen 1
- Gen 2
- Gen 3
- Gen 4

- Design
- Manufacturing
- Maintenance
- Operations

Most Severe Event Type (2013-2018)
Uncontained

Highest CAAM Level (2013-2018)
4

Data Substantiation
CAAM Events – 1 out of 2 CAAM 4 NTSB Safety Recs



# FAA CARB Data Analysis – Preliminary Areas for Discussion

Ni Melt Defects

High Energy LLP Failures

Manufacturing Quality Escapes / Supplier Oversight

Ability to withstand fan blade out loads/damage (inlet/cowl/nozzle separation)

Maintenance Challenges with Aging and Transitioning Fleets

Engine Health Condition Monitoring Systems

**Description:**

LLP uncontained failures continue to represent one of the most significant propulsion safety risks

**Discussion:**

Standing committees exist (RISC, ROMAN, JETQC) to continually identify improvements to design and manufacture of LLPs and have been successful at minimizing the occurrence of these failures

**Is this currently being worked?:**

Yes

**FAA Rule / Policy / Guidance Potential for Improvement?**

No

**EAEI Team Recommendation:**

Continue Existing Efforts

Gen 1

Gen 2

Gen 3

Gen 4

Design

Manufacturing

Maintenance

Operations

Most Severe Event Type (2013-2018)

Uncontained

Highest CAAM Level (2013-2018)

4

Data Substantiation

CAAM Events – 2 out of 7 CAAM Level Events  
 Driver of Multiple Events in CARB Dataset  
 Uncontained Disk Subteam Focus Area



# FAA CARB Data Analysis – Preliminary Areas for Discussion

Ni Melt Defects

High Energy LLP Failures

Manufacturing Quality Escapes / Supplier Oversight

Ability to withstand fan blade out loads/damage (inlet/cowl/nozzle separation)

Maintenance Challenges with Aging and Transitioning Fleets

Engine Health Condition Monitoring Systems

**Description:**

Manufacturing quality escapes contribute to in-service events

**Discussion:**

- Production ramp-ups to meet rapid fleet growth
- Design for manufacture and damage tolerance considerations
- Improve design and manufacturing interfaces both within FAA and within manufacturers
- Outsourcing/supplier arrangements

**Is this currently being worked?:**

No

**FAA Rule / Policy / Guidance Potential for Improvement?**

No

**EAEI Team Recommendation:**

Form joint Authority/Industry team to evaluate this potential issue and provide recommendations

Gen 1

Gen 2

Gen 3

Gen 4

Design

Manufacturing

Maintenance

Operations

Most Severe Event Type (2013-2018)

Uncontained

Highest CAAM Level (2013-2018)

4

Data Substantiation

CAAM Events – 2 out of 7 CAAM Level Events (1 out of 2 CAAM 4 Events)

Driver of Multiple Events in CARB Dataset



# FAA CARB Data Analysis – Preliminary Areas for Discussion

Ni Melt Defects

High Energy LLP Failures

Manufacturing Quality Escapes /  
Supplier Oversight

Ability to withstand fan blade out  
loads/damage (inlet/cowl/nozzle  
separation)

Maintenance Challenges with  
Aging and Transitioning Fleets

Engine Health Condition  
Monitoring Systems

**Description:**

Several inlet and cowl separations have occurred, resulting in one fatal accident.

**Discussion:**

- Fan blade size and evolution of design over time
- Airframe/Engine integration issue regarding assumptions and hardware used during certification testing

**Is this currently being worked?:**

Yes

**FAA Rule / Policy / Guidance Potential for Improvement?**

Yes – Policy/Guidance

May require new policy and changes to AC 20-128

**EAEI Team Recommendation:**

FAA to evaluate need for additional policy and guidance

Gen 1

Gen 2

Gen 3

Gen 4

Design

Manufacturing

Maintenance

Operations

Most Severe Event  
Type (2013-2018)

Uncontained

Highest CAAM  
Level (2013-2018)

4

Data Substantiation

CAAM Events – 1 out of 2 CAAM 4  
Events

Driver of Multiple Events in CARB  
Dataset



# FAA CARB Data Analysis – Preliminary Areas for Discussion

Ni Melt Defects

High Energy LLP Failures

Manufacturing Quality Escapes / Supplier Oversight

Ability to withstand fan blade out loads/damage (inlet/cowl/nozzle separation)

Maintenance Challenges with Aging and Transitioning Fleets

Engine Heath Condition Monitoring Systems

**Description:**

Older airframe and engine fleets are migrating to operators that do not have the knowledge and infrastructure in place to maintain them properly

**Discussion:**

- May need to come up with unique ways of reaching out to operators (ie – provide additional instructional information through social media)
- Is there anything that can be done in the area of ICA's?

**Is this currently being worked?:**

No

**FAA Rule / Policy / Guidance Potential for Improvement?**

No

**EAEI Team Recommendation:**

Form joint Authority/Industry team to evaluate this potential issue and provide recommendations

Gen 1

Gen 2

Gen 3

Gen 4

Design

Manufacturing

Maintenance

Operations

Most Severe Event Type (2013-2018)

Uncontained

Highest CAAM Level (2013-2018)

3

Data Substantiation

Uncontained Disk Sub-Team Finding



# FAA CARB Data Analysis – Preliminary Areas for Discussion

Ni Melt Defects

High Energy LLP Failures

Manufacturing Quality Escapes / Supplier Oversight

Ability to withstand fan blade out loads/damage (inlet/cowl/nozzle separation)

Maintenance Challenges with Aging and Transitioning Fleets

Engine Heath Condition Monitoring Systems

**Description:**

Engine manufacturers have systems that monitor engine conditions in real-time and produce alerts to the operators of actions they could take to prevent a future event

**Discussion:**

- Potential area for industry collaboration to enhance the usefulness and acceptance of these systems to prevent events

**Is this currently being worked?:**

No

**FAA Rule / Policy / Guidance Potential for Improvement?**

No

**EAEI Team Recommendation:**

Form joint Authority/Industry team to evaluate this potential issue and provide recommendations (potential panel discussion topic in October)

Gen 1

Gen 2

Gen 3

Gen 4

Design

Manufacturing

Maintenance

Operations

Most Severe Event Type (2013-2018)

NA

Highest CAAM Level (2013-2018)

NA

Data Substantiation

Driver of multiple events in the CARB dataset (that could have been prevented)



# Next Steps

- **FAA continues to refine list of contributing factors**
- **Review internally with leadership**
- **Set-up follow-on telecon with authorities**
- **Continue to share at this stakeholder forum**

