Guidance Material for use with CAAM Fire Zone Fire Data

This document is intended to provide the Continued Airworthiness Assessment Methodology (CAAM) Committee's assessment and interpretation of the High Bypass Ratio Fire Zone Fire data set. The companion Fire Zone Fire Background document outlines parameters and limitations of the published data and is complimentary to, and inseparable from, this material. Data assessed in this document was collected through the end of 2023. The Background document also provides key definitions that add context to the published data and this Guidance material. The insights provided in this Guidance are based on the collective experience of the CAAM Committee members.

It should be noted that any given issue may have nuances that make this material more or less applicable to that situation. This material is general in nature and should only be utilized in conjunction with a thorough assessment of the specific issue to which it is being applied. While this material was developed by practitioners with a wealth of experience, it is always possible that a given assessment is not valid for a specific issue being analyzed based on factors that can't currently be foreseen or contemplated. For these reasons care should be taken in the use of this material and the data it accompanies.

The following assessments are contained in this document:

I. Applicability of Data
II. Flammable Material Sources
III. Factors Affecting Progression to Level 3 Consequences
IV. Progression to Level 4/5 Consequences
V. Comparison of Current Data to Previous CAAM Reports

I. Applicability of Data

The exemplar Fire Zone Fire involves a flammable fluid leak within a designated Fire Zone that ignites due to the presence of an ignition source (e.g. hot surface, electrical arcing, etc.). The Fire Zone Fire data is intended to capture the consequences of this typical fire scenario with Hazard Ratios capturing the influences of the design/certification considerations of the Fire Zone. These considerations include Fire Zone boundaries/sealing intended to structurally contain the fire for a duration of time, detection systems to alert the flight crew to the presence of a fire, suppression/extinguishing systems, the ability to isolate flammable fluid (fuel & hydraulic) sources to the engine, Fire Zone drainage provisions, fire proof/fire resistant hardware within the Fire Zone intended to minimize the spread of a fire, as well as training/procedures for the flight crew to deal with the flight deck fire indications.

This data set also captures events (and can be used to assess hazards) for scenarios that closely mimic the typical fire. Examples of these types of events could include Fire Zone Fires resulting from a Starter or Integrated Drive Generator failure, a Nacelle contained disk fracture that does not compromise the Fire Zone, or a hot air leak/duct rupture that results in a subsequent fire igniting due to consequent damage to flammable fluid carrying lines or components. In these types of scenarios, the key consideration is that the characteristics that define the Fire Zone have been maintained. For this reason, the data is not applicable to events where the Fire Zone has been compromised such as nacelle uncontained disk fractures where the Fire Zone effectiveness has been adversely affected by the containment breach.

The typical fire includes a range of flammable fluid leak rates/volumes. Other variables that could affect fire progression and severity include performance of the detection & suppression systems and human factors such as flight crew reaction time. While this list is not exhaustive, the result is that the typical fire could include a range of damage from being localized to a small area around a specific fuel nozzle (Figure 1) to more widespread effects throughout the Fire Zone (Figure 2). As multiple factors affect the severity of the fire, the data set has been determined to be generally applicable to the range of fires observed. In other words, for the typical fire, it is not necessary to segregate the data by elements such as fluid source, leak location, rate, volume, etc. to establish a representative Hazard Ratio.

Figure 1

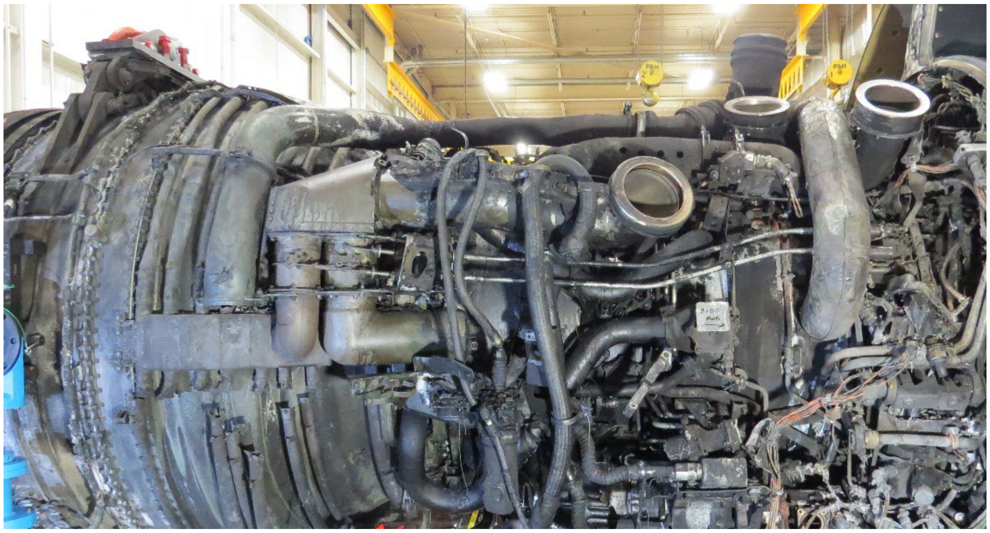

Figure 2

Care should be taken when using this data set for assessments involving events outside the scope of the data collection. For example, this data may not be applicable to fires that result from a Nacelle uncontained disk fracture – those hazards may best be captured by using the Uncontained Disk data set. Similarly, if the Fire Zone Fire was part of an event sequence that resulted in another CAAM category event, the hazards of that secondary event are not fully captured by this data set. For example, if the fire resulted in separation of a portion of the Nacelle (Parts Departing Airplane – PDA), the hazard associated with the PDA would not be captured by this data. Worded differently, event severity is due to the effects of the fire only.

Conclusion:

The Fire Zone Fire data set is applicable to a wide range of fires that initiate within an uncompromised Fire Zone. Care should be taken when using this data for events that have affected the integrity of Fire Zone prior to the fire. Hazards associated with other CAAM category events that are a result of the Fire Zone Fire are not captured by this data.

II. Flammable Material Sources

There are 201 fires contained in the current data set. The breakdown of flammable material sources for these fires is as follows:

Fuel:	124 [3 Level 3 events]
Oil:	48 [2 Level 3 events]
Unknown:	15
Hydraulic:	10
Fuel, Oil:	2
Oil then Fuel	1
Oil then Fuel & Magnesium:	1
Total	**201 [5 Level 3 Events; 0 Level 4/5 Events]**

While fuel and oil are the only two flammable material sources that have resulted in Level 3 consequences, there are an insufficient number of events involving other flammable material sources to establish that those sources have a higher or lower propensity to progress to Level 3 consequences.

Calculating Level 3 Hazard Ratios using data limited to a given flammable material source yields the following:

Fuel only: 3/124 = 0.024 (2.4%)
Oil only: 2/48 = 0.042 (4.2%)

While the Oil only ratio is higher, it is of the same order of magnitude as the Fuel only ratio. Further, given the small number of Level 3 events, a single additional Level 3 event could have a meaningful impact on the relative difference between these ratios. For these reasons, there is insufficient rationale to differentiate between Oil and Fuel fed fires with respect to progression to Level 3 consequences.

Conclusion:

There is insufficient reason to differentiate between the different flammable material sources with respect to the propensity to progress from Level 2 to Level 3 consequences.

III. Factors Affecting Progression to Level 3 Consequences

There were five (5) Level 3 events in the data as depicted in Figure 3 below.

Date	Engine Type	Engine Generatio	Installation	Type of Operation	Flight Regime	Narrative	Initial cause	CAAM Level
29-Aug-97	HBTF	Gen 2	Twin Fuselage	Passenger	Ground	On the ground engine experienced an incident resulting in 5 off LPC rotor blades failing at their roots and a further 3 off blades failing at mid height. Debris was contained. Debris from the failed blades ruptured the first flexible section of the main fuel line resulting in an engine fire. The fire caused blistering and severe cracking to the aircraft fuselage **[3B]**.	Fire Zone Fire	Level 3
09-Jul-98	HBTF	Gen 2	Twin Wing	Passenger	Air	Aircraft experienced #1 engine fire shortly after take-off. Flight crew shut down engine, F/W went out (due to detector damage) so they did not pull fire handle (therefore spar valve not commanded closed). Fire **[2C]** continued to burn , unknown to crew, for 18 minutes. Hot streak external to core cowl caused aluminum skin cowl to soften and rear latch assembly to pull free; cowls distorted and separated at back, allowing heat impingement and minor blistering on aircraft wing **[3B]**. Fuel leak at AGB idler adapter crossover tube fuel inlet due to improperly installed inserts.	Fire Zone Fire	Level 3
07-Nov-06	HBTF	Gen 3	Twin Wing	Passenger	Air	Flight crew reported a fire warning after VR at an altitude of ~ 50-100 ft. Commanded IFSD and Fire checklist carried out with the discharged of both fire bottles Smoke was observed coming from position 1 engine, extinguished by airport CFR crew. Fire **[2C]** originated as starter failure, consequent oil fire spread into reverser structure and ignited composite material in space between structures (low airspeed region outside fire zone) **[3B]**.	Fire Zone Fire	Level 3
02-Jul-17	HBTF	Gen 2	Twin Fuselage	Passenger	Ground	After landing roll, the crew received a left engine surge caution message, then left engine caught on fire (on taxiway), 2 extinguisher bottles released but did not put out the fire. Smoke in cabin was observed. Passengers were evacuated through the main cabin door. Fuel was observed puddling in the core cowl and drawing inside of the fan duct and poured onto the runway before being extinguished by ground crews **[3B]**.	Fire Zone Fire	Level 3
20-Feb-21	HBTF	Gen 3	Twin Wing	Passenger	Air	#2 engine failure while climbing after takeoff. the engine made an uncommanded shutdown and the engine fire warning activated shortly after **[2C]**. Crew discharged both fire bottles into the engine, but the engine fire warning did not extinguish until the airplane was on an extended downwind for landing. Single engine landing safely accomplished. Airport rescue and firefighting met the airplane as soon as it stopped on the runway and applied water and foaming agent to the right engine. The base of the engine experienced a flare up, which was quickly extinguished. There were no	Fire Zone Fire	Level 3

Figure 3

Three (3) Level 3 events (out of a total of 123) (2.4%) were recorded as occurring in Air, while two (2) Level 3 events (out of a total of 73) (2.7%) were recorded as occurring on the Ground[1]. While being on the Ground is referenced as a factor for progression to Level 3 consequences for one (1) of the events, the percentages do not indicate a meaningful difference with respect to Air/Ground as a factor in the probability of progression to higher level consequences.

Three (3) of the Level 3 events involved Generation 2 engines versus two (2) Level 3 events involving Generation 3 engines. Of the total population of fires, 132 occurred on Generation 2 engines, 41 occurred on Generation 3 engines, 18 occurred on Generation 4 engines, and the remaining 10 occurred on Generation 5 engines. The percentage of events that progressed to Level 3 consequences on Generation 2 installations (2.3%) versus Generation 3+4+5 (2.9%) does not indicate a significant difference in probability of progression to Level 3 consequences between Generation 2 and later Generation engines.

Three (3) of the Level 3 events occurred on Twin Wing installations while the remaining two (2) events occurred on Twin Fuselage installations. The Twin Wing and Twin Fuselage events account for 140 of the events in the database with a split of Twin Wing (113 events) versus Twin Fuselage (27 events). Of the two (2) Level 3 events on the Twin Fuselage installations, the proximity of the engine

[1] The total number of events (123+73=196) does not equal the total of 201 in the published data owing to 5 of the events being unknown with respect Air/Ground.

to the fuselage was noted to have been a factor in progression to Level 3 consequences for one (1) of the events. The percentage of events that progressed to Level 3 consequences on Twin Wing installations (2.7%) being lower than for Twin Fuselage installations (7.4%) combined with the fuselage proximity being identified as a factor in progression to Level 3 consequences, ***may*** indicate a bias for progression to Level 3 consequences for fuselage installations.

Two (2) of the five (5) Level 3 events (40%) involved engine internal mechanical failure (e.g. blade or air seal failure that did not compromise the Fire Zone) as part of the causal chain that preceded fire initiation. This contrasts with ~13 of the total of 201 events (6%) that involve turbomachinery failure initiating the event sequence. This indicates that events that do not involve a failure in the turbomachinery (e.g. leaking lines, ancillary component failure) are less likely to progress to Level 3 consequences than would otherwise be indicated by calculating a ratio using the entire data set.

The Committee attempted to collect data on flammable fluid leakage rate and quantity but was only able to obtain data/estimates on less the 5% of the events making an analysis of this factor not feasible.

Conclusions:

In Air versus on Ground does not appear to be a significant discriminating factor relative to progression from Level 2 to Level 3 consequences.

Engine Generation does not appear to be a significant discriminating factor relative to progression from Level 2 to Level 3 consequences.

Installation influences (e.g. wing versus fuselage) may have an influence relative to progression from Level 2 to Level 3 consequences.

Mechanical failure of the engine turbomachinery prior to fire initiation appears to be a circumstance that increases the probability to progress from Level 2 to Level 3 consequences relative to events that initiate with a flammable fluid leak or ancillary component failure without a preceding event in the turbomachinery.

IV. Progression to Level 4/5 Consequences

There are no events with CAAM Level 4/5 consequences in the Under-Cowl Fires[2] documented in the CAAM 1 (Reference [1]), CAAM 2 (Reference [2]), or CAAM 3 (Reference [3]) reports for High Bypass Ratio engines. This is notable given that those reports covered an expanded range of engines that included Generation 1 installations.

The CAAM 1, CAAM 2, and CAAM 3 reports also do not have any Level 4/5 Under-Cowl Fires for the older generation Low Bypass Ratio engines.

Given there are 201 Fire Zone Fires recorded in the current data set with five (5) Level 3 events, one methodology for estimating a Hazard Ratio for progressing from Level 3 to Level 4/5 consequences could be to simply assume the next event is a Level 4/5 event. Given the number of events captured in the current data set without progression to Level 4/5 consequences combined with the lack of an identified Level 4/5 consequence event in the prior CAAM reports, the Committee felt that the resulting 1/6 Level 4/5 conditional probability given a Level 3+ event using the next event assumption may not be representative of the actual threat and may be a pessimistic estimate.

As a way of refining the estimate, the Committee reviewed the Initial Release (current as of the publish date of this document) of the Uncontained Disk data set. Specifically, the review was limited to Uncontained Disk events that were graded Level 3 or higher and for which the fire associated with the event was attributed as a factor in grading the event Level 3 or higher. This data set has the advantage that it is a complete set of data; in other words, it is not biased by selecting a sub-set of events from a different genre that has not been studied thoroughly. Additionally, fires resulting from disk uncontainments are assumed to be at least as hazardous, if not more so, given that certain features intended to minimize the consequences of a Fire Zone Fire have been compromised (Fire Zone breach for example) or the fire is outside the Fire Zone and closer to airplane critical structure (e.g. in the vicinity of the strut/pylon, wing, fuselage, etc.).

The review of the uncontained disk data yielded a total of 10 events for consideration. Of these 10 events, three (3) events clearly involved penetration of a wing fuel tank and pool fire with resulting Level 4 consequences. These three (3) events were determined to not be representative of the threat of a Fire Zone Fire, specifically because of the size of the fuel leak and lack of ability to stop the leak. For a 4th event (also Level 4 consequences) it could not be determined where the fuel leak originated from that resulted in the fire, so the event was retained as part of the analysis along with the remaining six (6) applicable events. The inclusion of the event with an undetermined leak source also allowed for there to be a Level 4 event in the data set such that one did not need to be assumed for the purpose of estimating a Hazard Ratio. Details of the resulting seven (7) events are captured in Figure 3.

[2] See separate Fire Zone Fire Background document for explanation of the terminology change from "Under-Cowl Fire" to "Fire Zone Fire".

UID	Narrative – With respect to fire
C1970_0002	Uncontained separation of HPT 2nd stage disk rim with engine Fire Warning. Pylon structural damage, all fluid, electrical, and pneumatic lines in affected engine severed. Fire propagating over the top of the wing visible from within the airplane lasted for ~3 minutes and resulted in thermal damage to the surrounding area **[3B]**. Firewall fuel shutoff valve operated normally and terminated fuel supply to the engine.
C1992_0004	Uncontained separation of the fan rotor disc in low cycle fatigue of the right engine. Leaking fuel caught fire on the ground, causing severe damage to the aircraft fuselage. No injuries. Aircraft damaged beyond economical repair. Information is insufficient to establish whether the damage constitutes a Level 3 or 4. It has been graded as a 4 (consistent with CAAM2 report) due to fire causing the airplane to be an economic loss however there is no information to establish whether the damage would have been repairable on a higher value airplane. **[4]**
C1998_0002	Uncontained 360 degree fracture of the No. 3 engine HPT 2nd disk web/rim. Fire warning at 6,500 feet. Subsequent fire resulted in engine, pylon, and wing damage above the No. 3 engine, captain increased airspeed to 330kts to put out the fire (first fire bottle had been discharged, but second bottle failed to discharge) **[3B]**.
C2000_0002	Stg. 3-9 spool uncontainment. Main fuel inlet line separated from engine LP fuel pump. Pool fire around engine blistered paint and overheated lower wingskin **[3B]**. Fire announced by tower. Fire extinguished by airport fire trucks.
C2000_0005	Disk burst during maintenance ground run. Disk fragment through wing leading edge, damaging fuel inlet line. Pool fire **[3B]**.
C2002_0002	Uncontained HPC disk. 4" hole in cowling. Oil fire **[2C]** and hot gases escaped through the hole in the cowling and produced local paint blistering on the strut and adjacent wing **[3B]**.
C2015_0001	Uncontained HPC disk rim, main fuel supply line separated from fuel pump inlet, spilling ~97 gallons of fuel before spar valve was closed. Uncontrolled pool fire damaged inboard wing, left and right fuselage, substantial damage **[3B]**.

Figure 3

Combining these seven (7) events with the five (5) Level 3 events in Fire Zone Fire data set would indicate that the bounding conditional probability of progressing from a Level 3+ fire to Level 4/5 consequences as no higher than 1/12. Given the severity of the disk events, this ratio should be considered pessimistic in consideration of the Fire Zone Fire data set.

<u>Conclusion:</u>

The conditional probability for progression to Level 4/5 consequences given a Level 3+ event is recommended to be no more severe than 1/12 (less than 10%).

V. Comparison of Current Data to Previous CAAM Reports

A direct comparison between the Reference [1], [2], and [3] CAAM reports and the currently published data is not entirely possible. This is due primarily to the differences in the scope of the data between the different efforts, the most relevant difference being the inclusion of Generation 1 engines in the legacy reports that are out of scope for the current data set. Despite these differences meaningful comparisons can still be made within certain limitations.

The CAAM 3 report, covering the 2001-2012 reporting period, did tabulate Under-Cowl Fires[3] by High Bypass Ratio Engine Generation, allowing for a comparison of event counts over this timeframe. As noted in Figure 28 of Reference 3, from 2001-2012 there were 34 Under-Cowl Fires in the 2nd Generation fleet, and 17 Under-Cowl Fires in the 3rd/4th Generation Fleets. In the comparable timeframe in the currently published data there are 49 2nd Generation Fire Zone Fires and 17 3rd/4th Generation Fire Zone Fires. A deeper review of the data available to the Committee[4], including which events were submitted by which manufacturer, indicates that of the 49 2nd Generation events, 15 were reported by manufacturers who likely did not submit data to the CAAM 3 report (these same manufacturers did not have any 3rd/4th Generation events in the current data set). When these 15 events are accounted for there is an exact correlation between the event counts in the CAAM 3 report and the current data set over the analogous reporting period.

With respect to the events that were graded as Level 3 or higher in the CAAM 1, 2, & 3 reports, Figure 4 below provides a disposition of those events relative to the currently published data and standards (e.g. grading practices, consequence severity definitions, etc.).

CAAM Report	Event Narrative	Disposition
CAAM 1	Fire warning; air turn back; bleed signal manifold broken; angle gearbox housing burned; fire extinguished on ground. (hazard level 3.b.)	Out of scope, likely Generation 1 engine. Narrative does not support current definition of a Level 3 event. Grading at the time was likely due to fire being extinguished on ground. No airplane damage described.
CAAM 1	Gearbox fire from bearing failure spread to accessory zone; uncontrolled fire. (hazard level 3.b.)	Out of scope, likely Generation 1 engine. Narrative does not support current definition of a Level 3 event. Grading at the time was likely due to fire spreading from gearbox to accessory compartment - assuming this is still within Fire Zone. No airplane damage described.

[3] See separate Background document for a discussion on the change in nomenclature from the historically used "Under-Cowl Fire" category to the current "Fire Zone Fire" category.
[4] Data published in the public domain is de-identified in a such a way to protect the individual manufacturers while still conveying the most relevant information for the intended purposes of CAAM.

CAAM 1	Gearbox fire required ground equipment to extinguish. (hazard level 3.b.)	Out of scope, likely Generation 1 engine. Narrative does not support current definition of a Level 3 event. Grading at the time was likely due to the involvement of ground equipment to extinguish fire. No airplane damage described.
CAAM 2	Fire after landing from pylon fuel leak. Fire extinguished by ground crew (hazard level 3.b Event also included in Fuel leak (primary cause).	Out of scope based on current Fire Zone Fire data set bounding; leak initiated in pylon.
CAAM 2	Fuel leak due to improperly installed AGB component Fire warning during climb at 4000 feet; fuel was shut off at the HP shutoff valve, but the low-pressure fuel system remained pressurized. Fire continued to burn for 16 minutes until the airplane landed and the fire handles were pulled and the engine foamed. Core cowls opened and wrapped upward around the pylon, upper fire shoulder between fire zone and airplane was no longer in place. Wing panels were scorched and delaminated (hazard level 3.b.) Event also included in Fuel leak (primary cause).	Event included as a Level 3 event in current data set, UID = C1998_0005
CAAM 2	Fuel nozzle burnthrough impinged on adjacent primary fuel manifold. Major secondary fuel leak and undercowl fire, consumed 15% of core cowl in flight (3.b.) Event also included in Case burnthrough (primary cause).	Event was reviewed and downgraded to Level 2, included in complete data set as CID = C2000_0010
CAAM 2	Test flight. During reverse thrust, the tower indicated fire from the No. 3 engine. Fuel leak in pylon from hose nut near firewall. Fire bottles discharged, but fire extinguished by ground crew (hazard level 3.b.) Event also included in Fuel leak (primary cause).	Out of scope based on current Fire Zone Fire data set bounding; leak initiated in pylon.

CAAM 3	Fuel imbalance noticed during flight. Fuel leak from bleed actuator muscle line (chafed/fractured due to improper clipping arrangement). Fuel accumulated in bypass duct (not drained) and ignited during thrust reverse outside fire zone. Wind may have blown flames towards airplane. Airplane tailcone burned. Included in Fuel Leak (primary) and Under-Cowl Fire. (Hazard Level 3.b.) 2nd generation. Twin.	Event reviewed and determined to be out of scope based on current Fire Zone Fire data set bounding; fire was outside Fire Zone.
CAAM 3	Fire warning light illuminated during flight, aircraft returned to departure airport. Inspection found a seized air turbine starter, which was the origin of the fire. Hole in lower cowl, and thermal damage to composite outer bypass duct. (Hazard Level 3.b.) 2nd generation. Twin.	Committee was not able to associate this event with one in the current data set. Possible it was submitted by an entity not part of the current effort. From the damage description it is not clear this would meet current thresholds for Level 3 damage.
CAAM 3	External fuel leak, aircraft had fuel range issue caused by undercowl leak; diversion. Ignition of leaked fuel during landing rollout. Pressure pulse during ignition broke core cowl hinge, allowing fire to exit the fire zone. Event included in Fuel Leak (Primary) and Under-Cowl Fire. (Hazard Level 3.b.) 1st generation. Tri.	Out of scope based on Generation 1 engine, Narrative does not support current definition of a Level 3 event. Grading appears to be driven fire exiting Fire Zone. No airplane damage described.
CAAM 3	Aircraft accumulated ice slab in inlet overnight; ingestion of slab in takeoff roll separated two fan blades below the mid-span, which were forward arc uncontained. The inlet adapter ring and bellmouth which form part of the fan fire zone boundary were destroyed. The fuel supply line, routed along the inlet, was damaged by fan blade fragments and the fuel ignited. Since the initiating event destroyed the fire zone boundaries, the fire was not limited to the fire zone. Included in Uncontained Blade (primary) and Under-Cowl Fire. (Hazard Level 3.b.) 1st generation. Tri.	Out of scope based on Generation 1 engine. Narrative does not support current definition of a Level 3 event. Event would also be out of scope due to uncontainment compromising Fire Zone.

CAAM 3	Hung start during taxi out to departure runway, with tail winds of 23 knots gusting to 29. Trailing flight crew reported flames and smoke coming out of the intake and exhaust, and torching the fuselage. The crew discharged fire bottles. Inspection found thermal damage to fan bypass vanes, outer bypass duct, and engine wiring harness. (Hazard Level 3.b.) 2nd generation. Twin.	Out of scope based on current Fire Zone Fire data set bounding; fire was outside Fire Zone.
CAAM 3	HPC1 disk burst during takeoff; RTO. Fire damaged engine and impinged on wing. Included in Uncontained Disk (primary) and Under-Cowl Fire. (Hazard Level 3.b.) 2nd generation. Twin.	Out of scope based on current Fire Zone Fire data set bounding; uncontainment compromised Fire Zone.
CAAM 3	Fire warning at rotation. IFSD and ATB due to starter failure. Undercowl oil fire spread to Left Hand Fan Reverser causing burn through. Fire burned out through cowl. (Hazard Level 3.b.) 3rd generation. Twin.	Event included as a Level 3 event in current data set, UID = C2006_0008

Figure 4

As can be observed in the above Figure, all differences between the prior CAAM reports and the currently published data with respect to Under-Cowl/Fire Zone Fires have been evaluated and explained.

A similar comparison can be made with the five (5) events graded Level 3 in the current data set. Of these five (5) events:

- Two (2) occurred after the CAAM 3 reporting period
- Two (2) of the events (C1998_0005 & C2006_0008) were captured as Level 3 in the previous CAAM reports (see Figure 4 above)
- The remaining event (C1997_0004) occurred during the CAAM 2 reporting period but does not appear to have been included as a Level 3 event in that report. This event has been reviewed by the manufacturer with the conclusion it may not have been identified as a Level 3 at the time of the CAAM 2 report either due to the fire being a secondary event to the rotor blade failure or the severity of the fire not meeting Level 3 thresholds based on the definitions used by the CAAM committee at that time.

Conclusion:

To the extent that it is possible to compare data sets, there is consistency between what has been published in the CAAM 1, 2, & 3 reports for Under-Cowl Fire data and the currently published Fire Zone Fire data. All differences have been explained, and it is recommended that the currently published data set replace the prior work.

References

[1] Technical Report On Propulsion System and Auxiliary Power Unit (APU) Related Aircraft Safety Hazards; A joint effort of The Federal Aviation Administration and The Aerospace Industries Association; October 25, 1999 (CAAM 1 Report)

[2] 2nd Technical Report On Propulsion System and Auxiliary Power Unit (APU) Related Aircraft Safety Hazards; A joint effort of The Federal Aviation Administration and The Aerospace Industries Association; January 31, 2005 (CAAM 2 Report)

[3] 3rd Technical Report On Propulsion System and Auxiliary Power Unit (APU) Related Aircraft Safety Hazards; A joint effort of The Federal Aviation Administration and The Aerospace Industries Association; March 30, 2017 (CAAM 3 Report)

Revision History

19 November 2025 – Initial Release