



AVIATION ACCIDENT INVESTIGATION REPORT

EA-18G, A46-311, Uncontained Engine Failure, Nellis Air Force Base, Nevada, USA, 27 Jan 18



EA-18G accident aircraft
ablaze (snapshot taken
from USAF Go-Pro)

EXECUTIVE SUMMARY

1. On 27 Jan 18, a 6 Squadron EA-18G 'Growler', A46-311, experienced an uncontained F414 engine failure during the latter stages of its take-off roll at Nellis Air Force Base (AFB), Nevada, USA. At ~140 knots indicated air speed (KIAS), the ballistic material failure of the right hand engine caused the almost simultaneous failure of the left hand engine, a cascading set of malfunctions and emergencies and a fierce fuel / airframe fire.

2. Confronted with a marked increase in vibration and ambient noise, the crew completed their 'bold face' actions for multiple major malfunctions. About four seconds after the failure of both engines, the situation was further compounded by the loss of all generated electrical systems; which disabled, amongst others, the Digital Display Indicators (DDIs), Multipurpose Colour Display (MPCD), Head-up Display (HUD) and anti-skid braking. Whilst under emergency (system) braking, both the left and right main undercarriage tyres burst, severing the hydraulic line that serves the left hand undercarriage brake.

3. The aircraft was kept on the runway using a combination of differential braking (from a dissipating hydraulic system) and aerodynamic / physical drag. Approaching the runway's first arresting barrier, the aircraft departed the prepared surface to the right (at about 8,400 feet of the 10,000 foot runway). Carrying an estimated 50 knots of

groundspeed into the sand based margin, the aircraft passed outboard of the starboard anchor housing for the arrestor cable. Remaining upright and influenced by the additional drag of the sand, the aircraft slowed and yawed left (back through the runway heading) before coming to rest on an adjoining intersection, marginally right of the runway in use, 9,100 feet from the initial departure point. Confronted by the significant fuel / airframe fire, the aircrew made a rapid egress from the cockpit, via the port side of the leading edge extension (LEX), gathering at a safe point upwind of the aircraft. The pilot was later treated for smoke inhalation, whilst the Electronic Warfare Officer (EWO) remained physically unharmed (save bruising).

4. The event was classified as an accident, which triggered the formation and dispatch of a DDAAFS Aviation Accident Investigation Team (AAIT) to the USA. Aircraft fragments recovered at the scene of the accident indicated that the right hand engine of A46-311 had suffered an uncontained failure of the 1st stage fan disc, which instigated the accident 'chain of events'.

5. The AAIT undertook a comprehensive investigation into the causal factors behind the failure of 1st stage fan disc. In parallel, the AAIT also analysed potential contributing factors to the accident sequence and all associated human and aviation medical factors prior, during and post the

accident. During the investigation, the AAIT made use of engine's Original Equipment Manufacturer (OEM) specialist facilities, proprietary information, aircrew and engineering subject matter experts (SMEs), computer based training and aircraft simulation.

Significant findings

6. The failed component from the right hand engine was manufactured from Ti-17 titanium alloy and had accrued 147 engine operating hours. Three 1st stage fan disc segments, comprising the entire 360° of the failed component, were recovered in the vicinity of the accident site. Segment one was ejected directly into the runway underneath the aircraft. Segment two was located on an adjacent runway 300 meters to the right of where the right hand engine initially failed and segment three, the largest segment, was lodged within the intake duct of the left hand engine of A46-311.

7. The fracture surface on segment two exhibited an initial surface-connected zone of discoloured material consistent with tensile overload, followed by a 'clean' metallic region of progressive crack propagation. Identical features were found on the matching fracture face from segment three after soot (from the left hand engine) was cleaned from its surface. OEM laboratory analysis of the fracture surface revealed that the failure of the 1st stage fan disc was due to a defect present within the disc at manufacture, which propagated through normal engine cycling until it reached a size that resulted in the fracture of the component.

8. The uncontained failure of the 1st stage fan disc was considered to be an unusual event by metallurgists. Subsequent discussions with the OEM sub-contractor responsible for producing the 1st stage fan disc forgings revealed that they had previously experienced three

cracked forgings during manufacture, affirming the conclusion that the failure of A46-311 engine component was introduced during the forging process.

9. 1st stage fan discs originate from forging lots, with varying numbers of forgings comprising a lot. A cracked 1st stage fan disc was from the OEM's sub-contractor Lot 61, forged in 2015. It was one of 31 forgings in the Lot. Initially, there were three Lots of interest which were installed in in-service F414 engines, necessitating both the RAAF and USN to introduce an operational pause (OP) to F414 engine flying operations. One third of the RAAF's F414 engine fleet were, by analysis, affected and subsequently investigated.

Recommendations

10. Only three recommendations are made by the AAIT and none are directly safety related. One recommendation relates to embedding medical personnel into ACG detachments (operating outside of Australia) and the other two are aimed at remediating the current ADF data compilation and analysis capability (vide safety investigations).

Safety action already taken

11. Once the initiating component (1st stage fan disc) that triggered the accident sequence had been identified, the AAIT immediately liaised with all relevant EA-18G stakeholders within CoA and the USA in order to establish causal factors and reduce the probability of a recurrence (of the uncontained failure) so far as possible.

12. Thereafter, the accelerated information flow between the OEM, the USN F/A18 / EA-18G Program Office and RAAF agencies resulted in period of OP to RAAF F414 engine aircraft and a series of risk mitigation strategies to safely manage F414 engines back into operational service.

