

**IN THE SHERIFFDOM OF GLASGOW AND STRATHKELVIN**

**AT GLASGOW**

Under the Inquiries into Fatal Accidents and Sudden Deaths etc. (Scotland) Act 2016

**WRITTEN SUBMISSIONS**

**on behalf of**

**James Diver, Bereaved of his father**

**SAMUEL BELL MCGHEE**

**in the Inquiry into the deaths of Gary Louis Arthur and Others.**

1. In relation to the Findings in Fact proposed by the Crown, no issue is taken, save for the following:-
  - At paragraph 12 the Crown propose “The helicopter’s Caution and Advisory Display (CAD) displayed caution and advisory messages and fuel contents indications.” It is respectfully submitted that whilst this reflects what could be expected of the avionics suite fitted to G-SPAO, there is no evidence available to the Inquiry as to what was actually displayed on the Caution and Advisory Display in the course of the aircraft’s ultimate flight;
  - At paragraph 47, reference is made to Crown Production 290. It is observed that whilst this was information available to pilots, it was not prescribed reading for pilots or other crew members.
  
2. Given the above, the following findings in fact are proposed as insertions or *addenda* to the ones proposed by the Crown:-
  - i. That as the aircraft’s Caution and Advisory Display (CAD) does not utilise non-volatile memory recording fuel level status. As a consequence there is no

evidence available to the Inquiry as to what fuel levels were being displayed to the pilot and crew;

- ii. That the explanation as to the description of the fuel tank design referred to in “The System Description Section of the Aircraft Maintenance Manual “(CP 290), produced by the manufacturer to inform engineers and technicians of the features of the EC135, was not prescribed reading for pilots or other crew.

3. In relation to the composite List of Issues for the Inquiry, these are dealt with **only** where there is/are (an) additional submission(s) to those offered by the Crown. For Convenience, the Crown numbering is repeated. They are thus:-

- i. **4. The cause or causes of the helicopter crash, including:-**
  - 4.1. how fuel was managed on the aircraft and in particular why both transfer pumps were switched OFF, rendering unusable the otherwise usable fuel in the main tank;**

- a. There is ample evidence before the Inquiry that both transfer pumps were set to “OFF” in the course of the aircraft’s ultimate flight. The observations post-accident of switch positions are supported by the depletion of both supply tanks, and the consequential double flame out. Affirmation comes from tests concluding the transfer pumps were functional. There is no evidence of malfunction in the CAD system suggesting messages confirming the switch off did not appear;

- b. It is not unreasonable to conclude that the forward pump was either switched off in error, or that it was intentionally switched off following a 3 minute dry running period, and for an unascertained reason, never returned to “ON”. No issue is taken with paragraph 4.1.7 in the Crown Appendix. Without any form of cockpit voice recorder or video recording, or flight data recorder, the precise reasons for the switches being set as they were cannot be known;

- c. Whilst there are indications given via the CAD that a fuel pump has run dry for 3 minutes, there is not subsequent indication that said pump has been re-submerged in fuel, and therefore available pump fuel. (Vickery 5:97:6-9);

- d. There is no specific indication included in the avionics suite of the aircraft to indicate to a pilot that both transfer pump switches are set to “OFF”. (Vickery 5:99:2-22 )It is submitted that such a situation goes beyond that

which is a caution, and escalates to that which ought to be a warning. It is a situation incompatible with safe continued flight. (Vickery 5:101:16 – 5:102:2). See recommendations section *infra*.

ii. **4.5 Why, having acknowledged the LOW FUEL warnings, did the pilot not complete the actions detailed in the Pilot’s Checklist;**

Crown hypotheses 4.6, 4.8 and 4.9 will be addressed as appropriate. Under this paragraph however, certain factual considerations are founded upon, the submission being that these should be included in any findings in fact. They are thus:-

- That the pilot was a highly experienced rotorcraft aviator, and considered an above average pilot;
- That the pilot was assisted by two well trained Police observers, one of whom was very experienced, and both of whom would understand CAD messages;
- That had the CAD been displaying fuel readings accurately indicating actual fuel on a tank by tank basis, it would have been apparent to the crew as a whole that the supply tanks were depleting;
- That Air Traffic Control communication, including a request to enter Glasgow Controlled Airspace were routine in nature, and delivered without urgency;
- No “PAN-PAN” declaration was made;
- No emergency communications were made using Police AirWave radio highlighting any issue;
- That at a time when a properly functioning CAD system taking information from a properly functioning fuel level indication system, it would be expected to have been indicating perilous fuel readings, yet the crew collectively undertook a mission over Bargeddie;
- That at a time when the thermistor driven “LOW FUEL” warnings must have been being repeatedly illuminated, there is no evidence of the pilot or his crew having any sense of peril or urgency.

iii. **4.6. whether the timing and/or the initially intermittent character of the LOW FUEL warnings contributed to the Pilot’s Checklist procedure not being completed;**

- a. Reference is made to paragraph 3(2) *supra*, dealing with List of Issue 4.5;
- b. Not only was the LOW FUEL warning procedure apparently deviated from by the pilot, but neither police crew member made any communication. Whilst the reason why is a matter of speculation, what is not is that no efforts appear to have been made to rectify or mitigate the situation, nor communicate it beyond the cockpit. It is not unreasonable to conclude that Police crew members must have been satisfied by a plausible explanation from the pilot. This, logically, can only have been a reassurance that the aircraft had sufficient fuel; reassurance that it was available from the appropriate supply tank and reassurance that there was no emergency developing. The intermittent nature of the alarms would be a credible reason to offer plausible reassurance to the crew.

**iv. 4.8. whether the pilot believed the fuel transfer pumps were operating, notwithstanding the LOW FUEL warnings, because he believed he had switched the fuel transfer pumps back ON, and if so whether the design or layout of the switches contributed to such errors occurring;**

- a. There is simply no evidence as to whether Captain Traill had any beliefs, one way or another, as to whether he had switched the transfer pump switch(es) to “ON”. All that can be said is that he did not take any effective action to rectify that situation, apparently flying and undertaking an additional detail to the tour in transiting the aircraft to Bargeddie;
- b. The circumstances of the latter stages of the flight, including the Bargeddie mission, are indicative of a crew who did not perceive there to be a danger to the aircraft.

**v. 4.9. whether the pilot believed the transfer pumps were operating, notwithstanding the LOW FUEL warnings, as a result of erroneous fuel indications being displayed on the CAD;**

- a. One of the challenges of the Inquiry taking place 5 ½ years after the loss of G-SPAO is that the state of knowledge amongst witnesses of the fuel system of an EC135 T2 aircraft will have been expanded in the wake of the loss of this aircraft, and analysis of the investigations by anyone involved in EC135 air transport. It is impossible retrospectively to ascertain Capt. Traill’s understanding of the fuel indication system;

- b. What can be observed is that in the flight manual for G-SPAO but four lines are devoted to the “LOW FUEL 1/2”. These are to be found on page 7-26 (electronic page 515 of Production 214), and is in the following terms:-

*A warning light is activated by the respective low level sensor that indicates that the remaining fuel quantity in the respective supply tank cell is below the defined threshold value. The low level sensors receive their power from the No. 1 DC essential bus through the FUEL-L SYS I or FUEL-L SYS II circuit breakers, located on the overhead console.*

In particular, no reference is made to the means of low level warning compared to fuel level indication, nor which has precedence;

- c. The evidence of pilots’ understanding can be gleaned from the Evidence of Capt. Rooney. Cf day 25 as a whole. In particular in relation to the low fuel warning system, there seemed to be a lack of understanding of its absolute operational distinction from level indication system. (Rooney 25:167:2-18);
- d. Moreover a fleet “confidence check” post the loss of G-SPAO demonstrated fuel anomalies thereafter. (Rooney 25:170-171) This check demonstrated the unreliability of fuel gauges;
- e. Given the lack of understanding of the fuel level indicator system compared to and distinct from the Low Fuel warnings amongst pilots in 2013, it is not unreasonable to query this as a factor in this accident. When considered along with an apparent lack of concern on the part of Capt. Traill, a lack of reaction by his crew, the lack of PAN-PAN protocol, and the routine nature of cockpit communication with ATC, the only evidence available is of a crew seemingly unconcerned with their flight, and planning a return to the heliport. This is not easily reconciled with the repeated LOW FUEL 1 and LOW FUEL 2 warnings recovered from non-volatile memory if those warnings were being accepted as accurate by the crew. It is logical that if those warnings were being doubted, they must have been doubted for a reason. Inaccurate gauge readings are the only alternate source of information. On the basis that confidence checks post

incident demonstrated anomalies across 40% of the operator's EC135 fleet, the Inquiry is confronted with a reason as to why warnings might be ignored, namely contra indication;

- f. Such a scenario is in keeping with the retrospective scepticism felt by Capt. Mortimore as to the accuracy of fuel gauge readings at lower levels; (26:131:10 – 132:16)
  
- vi. **5.1. (The precautions, if any, which could reasonably have been taken, and which, had they been taken, might realistically have resulted in the helicopter crash being avoided, including whether the crash might realistically have been avoided) by including within the fuel contents indication system a caution or warning that both transfer pumps were switched OFF & 5.2 by including within the fuel contents indication system a caution or warning that a fuel pump, having been switched OFF, has since been submerged in fuel**
  - a. See 3(i)(c)&(d) *supra re 4*;
  - b. It is submitted that a warning lamp would not be unreasonable to confirm to a pilot in command of an aircraft that it was configured in a manner incompatible with continued safe flight.
  
- vii. **5.3. by designing the fuel tank system and fuel contents indication system in such a way that the fuel transfer pumps did not require to be switched ON or OFF during flight;**
  - a. cf Mendick Day 8 generally;
  - b. G-SPAO, being aircraft number 546 of the EC135 fleet was fitted with fuel pumps manufactured by Test Fuch. Of a global fleet of around 1,500, aircraft post number 200 are fitted with these pumps. The original 200 aircraft were fitted with pumps of a different design manufactured by Globe;
  - c. Test Fuch pumps can be retrofitted to aircraft originally manufactured with Globe pumps;
  - d. It is unknown how many original Globe pump equipped aircraft are now equipped with Test Fuch fuel pumps;

- e. Globe pumps could only sustain 20 minutes of dry running. Test Fuch pumps could sustain repeated dry running periods in excess of the range of the aircraft; Mendick (8:160-176)
- f. Whilst the Globe pump equipped aircraft did require fuel pumps to be switched off to avoid damage through dry running, Test Fuch equipped aircraft did not;
- g. The flight manual for the EC135 was based on the earlier pump design;
- h. It is somewhat ironic that the procedure, albeit one potentially improperly executed or improperly monitored, that gave rise to this aircraft enduring a loss of power due to fuel starvation was one that was entirely unnecessary in this specific aircraft;
- i. Put shortly, the fuel delivery system has been redesigned (in using Test Fuch pumps) in a way that removes transfer pump switching from the pilot's burden in normal flight, but the flight manual and avionics suite has not been updated to take account of the development;
- j. It does not seem unreasonable for the flight manual, at the very least, to be updated to remove the unnecessary human factored fuel management procedure from pilots operating Test Fuch pump equipped aircraft. The only downside of such a course could be to further split the type rating of pilots into two sub types depending on the fuel pump equipment fitted;
- k. Given that a maximum of 200 aircraft of a global fleet of 1,500 remain equipped with the older Globe pumps, it does not seem unreasonable to recall those aircraft for retrofitting of Test Fuch pumps. This would avoid any split in type rating, and the fuel management procedure for dry running pumps simply eliminated across the whole fleet;
- l. Had either submission j. or k. above been implemented prior to 29 November 2013, this accident would not have occurred.

#### Recommendation

- 4. Sections 26(1)(b) and 26(4) of the Inquiries into Fatal Accidents and Sudden Deaths etc. (Scotland) Act 2016 gives the court power to make recommendations in relation to specific matters 'which might realistically prevent other deaths in similar circumstances'. The following recommendations are commended to the Court to prevent similar future catastrophes in aircraft of this type:-**

- i. Had G-SPAO been flown without the need to switch transfer pumps to OFF after 3 minutes of dry running, this accident would not have occurred. This procedure was *de facto* unnecessary on that aircraft. It is submitted that a recommendation that Test Fuch pump equipped aircraft should be flown to parameters of those pumps, and not to the parameters of pumps historically used, and now used in a maximum of 13% of the fleet. This would involve the rewriting of a short part of the flight manual, and the splitting of type ratings.

**alternatively**

Given that a maximum of 200 aircraft of a global fleet of 1,500 remain equipped with the older Globe pumps, these aircraft should be mandatorily retrofitted with Test Fuch pumps. This would avoid any split in type rating, and would eliminate the fuel management procedure for dry running pumps across the whole fleet;

- ii. That consideration ought to be given to the retrofitting of a red “warning” indicator, independent of the CAD to inform pilots that both transfer pumps are set to “OFF”, a situation incompatible with continued safe flight;
- iii. That pilot training formally includes training in the manner of fuel detection across the two systems of capacitance tube senders to gauges, and thermistor generated LOW FUEL warnings. Specifically, the independence of the two systems should be emphasised, and precedence ordained to the LOW FUEL warnings. The lack of historical anomaly in the thermistor driven system ought to be emphasised to all EC135 rated pilots.

IN RESPECT WHEREOF

Anthony J. Graham QC et

Louise M. Arrol



Counsel for James Diver

Glasgow, 30 July 2019