DEPARTMENT OF INDUSTRY AND COMMERCE

THE AIR NAVIGATION (INVESTIGATION OF ACCIDENTS) REGULATIONS 1928 to 1943

R E P O R T

OF THE FORMAL INVESTIGATION INTO THE CAUSES AND CIRCUMSTANCES OF THE ACCIDENT WHICH OCCURRED ON THE 1st of JANUARY, 1953, TO THE DC-3 AIRCRAFT EI-ACF.

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3, Eglinton Road,
Donnybrook,
Dublin.

17th June, 1953.

Sean F. Lemass, Esq.,
Minister for Industry and Commerce.

Sir,

The Court appointed by you to investigate the causes and circumstances of the accident which happened to Aircraft EI.-ACF on the 1st January last, having now completed its deliberations, I send you herewith the Report signed by myself and the Assessors.

I desire to record my appreciation of the very great assistance given by the Assessors, Captain Van den Honert, Commandant Swan and Commandant Teague.

Our work was very much eased and the public very much convenienced by the privilege of accommodation in the Courts of Justice.

Public Sittings were held at the Four Courts on 19th, 20th, 21st, 22nd, 23rd, 26th, 27th, 28th, 29th, 30th of May, 1953, and 1st June 1953.

The Court also met in private for consideration and preparation of the Report, on 2nd, 3rd, 4th, 5th, 6th and 8th June 1953.

The Court inspected a D.C.3 Aircraft at Dublin Airport on two occasions.

I wish to take this opportunity of expressing the indebtedness of the Court to its Registrar, Mr. Angelo Murphy, for his invaluable assistance throughout the Enquiry.

Your obedient servant,

(Sgd.) Thomas Teevan.

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REPORT OF THE FORMAL INVESTIGATION INTO THE CAUSES AND CIRCUMSTANCES OF THE ACCIDENT WHICH OCCURRED ON THE 1ST OF JANUARY, 1953, TO THE DC-3 AIRCRAFT EI-ACF.

AIRCRAFT: DC-3 EI-ACF.

ENGINES: Two Pratt and Whitney Twin Wasp

REGISTERED OWNERS AND OPERATORS - Aer Lingus-Teoranta

CREW: Captain Thomas J. Hanley,
First Officer: Patrick J. Whyte,
Hostess: Philomena McCluskey.

PLACE OF ACCIDENT:- Spernall, Warwickshire, England

DATE AND TIME : 1st of January, 1953, at about 11.04 hrs. G.M.T.

(All times stated in this Report are G.M.T.)

INTRODUCTION

1. At 09.36 hrs. on the 1st of January 1953, the DC-3 aircraft EI-ACF belonging to and operated by Aer Lingus Teoranta (hereinafter called "Aer Lingus" or "the Company") took off from Dublin Airport en route for Birmingham. The aircraft was manned by a crew of three, that is a Captain, a First Officer and a Hostess and carried 22 passengers and a small quantity of cargo, of no significance to this Enquiry. The take-off weight of the aircraft was 11,433 kg. as against an authorised maximum take-off weight of 12,227 kg.

2. The route chosen was by way of Point Lynas, Wallasey, Whitegate and Lichfield to Birmingham. The flight was without incident as far as Lichfield, which was reached at 10.56 hrs.

3. Shortly after Lichfield both engines lost power when flying at a height of about 5000 feet and the aircraft made a forced landing in a field at Spernall, Warwickshire, 14½ miles SSW of Elmdon Airport. The aircraft was extensively damaged, all passengers and the crew with the exception of the co-pilot escaping without serious injury.

4. The main problems for the Court were to ascertain the cause of the engine failure and whether the accident could have been avoided notwithstanding such failure.

PART 1. THE AIRCRAFT

a/ ITS HISTORY

5. The aircraft, a Douglas DC-3 D, built by the Douglas Aircraft Corporation, Inc. of Santa Monica, California, U.S.A., under the serial number 42957, was delivered to Aer Lingus on the 24th February 1946 and was duly registered under the nationality and registration marks EI-ACF, the Certificate of Registration No. 66 being issued on the 1st of March, 1946.

6. To date the 1st of January 1953 it had completed a total flying time of 10968 hours 35 minutes. Since the last checks 7 and 8 - completed on the 16th of December 1952 - it had flown 85 hours 55 minutes. The Certificate of Airworthiness No. 18 was last renewed on the 20th of February 1952 and was valid until the 19th of February 1953.

7. The Port engine, No. 356655, had completed 85 hours 55 minutes since last overhaul to date the 1st of January 1953, the Starboard engine, No. 361759, had completed 462 hours 20 minutes since last overhaul to date the 1st of January 1953, both well within the limits laid down, the approved time to overhaul being 900 hours.

8. The propellors and other component parts, and instruments were also well within the limits of their respective approved times to overhaul.

9. The Certificate of Safety was issued at 06.00 hours on the 1st of January 1953 on completion of a check 2 (100 hours inspection) and was valid until 06.00 hours on the 5th of January 1953.

b/ ITS LOADING

10. On the flight to Birmingham on the 1st of January 1953, EI-ACF carried, apart from its normal equipment and fuel, a crew of two pilots and a hostess, 22 passengers, 308 kg. of baggage, and 87 kg. of cargo, the total weight being 11433 kg. or 25199 lbs., well under the maximum permissible take-off weight allowed by the Certificate of Airworthiness which states a maximum of 26900 lbs.

11. An error in the setting-out of the fuel distribution on the load and trim sheet, had no appreciable effect on the trim, which also was within the limits laid down in the Certificate of Airworthiness.

PART II. THE CREW

12. Captain Thomas James Hanley, stated to be about 47 years of age, was in the possession of an Airline Transport Pilot's licence No.32, endorsed for Douglas DC-3 aircraft, issued on the 8th of November, 1951 and valid until the 5th of May 1953. His instrument rating was valid untill the 3rd of March 1953. He was also the holder of a Flight Radio Operator's Licence Radiotelephony (General) No. 88, issued on the 3rd of March 1952 and valid until the 5th of November 1953. He had last had a line check on the 12th March 1952.

Captain Hanley had completed to date the 1st of January 1953 a total number of flying hours of 7303 hours 05 minutes of which 3369 hours 50 minutes had been as first pilot on DC-3 aircraft.

He was very familiar with the Dublin-Birmingham route and the Elmdon Airport.

13. First Officer Patrick Joseph Whyte, stated to be about 30 years of age, was the holder of an Airline Transport Pilot's licence No.66, endorsed for Douglas DC-3 aircraft, issued on the 29th of December 1952 and valid until the 15th of April 1953. His instrument rating was valid until the 21st of October 1953. He was also in possession of a Flight Radio Operator's licence Radiotelephony (General) No. 42 issued on the 4th of July 1951 and valid until the 23rd of April 1953. He had had a line check on the 16th of November 1951.

F/O Whyte had flown a total of 3599 hours 25 minutes to date the 1st of January 1953, of which 2668 hours 20 minutes were as co-pilot on Douglas DC-3 aircraft.

He too was very familiar with the Dublin-Birmingham route and the Elmdon airport.

14. Captain Hanley and First Officer Whyte had flown together on eight previous occasions during 1952, five of which were during the month of December.

15. The third member of the crew was the hostess, Philomena McCluskey, who had been on flying duties with Aer Lingus since April 1952.

16. The minimum crew required by the Certificate of Airworthiness is two pilots so that this condition was complied with.

PART III. THE FLIGHT

a/ PREPARATION OF THE AIRCRAFT

17. The aircraft had been refuelled between 05.45 hrs. and 06.00 hrs. on the 1st of January 1953 to the normal fuel load of 300 Imp. gals. for the stretch from Dublin to Birmingham, distributed in the following manner:- Left Main tank 120 Imp. gals., Right Main tank 115 Imp.gals. and the Right Auxiliary tank 65 Imp. gals. After re-fuelling the tanks had been dipped and the quantity and distribution entered in the fuel and oil record. In addition 16 Imp. gals. of oil were carried in each of the two oil tanks, 8 Imp. gals. of de-icer alcohol in the windshield and carburettor de-icer tank and 3½ Imp. gals. of de-icer alcohol in the propeller de-icer tank. These quantities were also entered in the fuel and oil record which is attached to the technical log issued to the pilots.

The accuracy of the dip at Dublin Airport is stated to be plus or minus 2 Imp. gals. for fuel according to the Company's Aircraft Operating Instructions.

b/ PREPARATION FOR THE FLIGHT

18. Captain Hanley arrived at the Airport at 08.40 hrs. and found that F/O Whyte had already collected the flight forecast giving particulars of the en route weather, including winds and temperatures aloft, terminal and alternate forecasts. He, Captain Hanley, discussed the weather conditions with F/O Whyte and gave him instructions regarding the preparation of the flightplan. The calculated fuel required for the flight was 105 Imp. gals. plus 10 Imp. gals for taxying, run-up and take-off, a total of 115 Imp. gals. A further 50 Imp. gals. was calculated as required for diversion to an alternate airfield leaving a reserve of 135 Imp. gals., so that the total available fuel quantity of 300 Imp. gals can be considered more than sufficient for the flight. The flightplan showed no errors in the calculation other than a mistake in addition in the "total time" column of 1 minute which would not have a noticeable effect on the fuel quantity required.

19. Having given F/O Whyte his instructions, Captain Hanley then saw to the signing of the ship's papers and went out to the aircraft, to find F/O Whyte already there, either engaged in the checking of the radio equipment, or having just completed that check.

20. According to the evidence of Captain Hanley and F/O Whyte, they together went through the pre-starting check-list, F/O Whyte reading out the items and Captain Hanley checking them. In the case of the fuel quantity check, the co-pilot turned the selector switch while the Captain watched the gauge.

21. Again according to the evidence of the pilot and co-pilot, the check of the cockpit fuel selectors was read out by F/O Whyte, who himself moved the starboard selector to the Right Main position. Captain Hanley states that he then moved the port selector to Left Main and checked the starboard selector in the Right Main position by putting his hand across and feeling it.

(As the check items relating to fuel quantity and fuel tank selection become of importance in determining the cause of the engine failure and the accident to the aircraft, the evidence in relation to these parts of the check, and the reliability of this evidence, is considered more fully in paragraphs 45 and 46)

22. The aircraft was then taxied out to the runway, where the run-up and pre-take-off check were completed, and, after receiving its clearance, took off at 09.36 hrs.

c/ THE FLIGHT TO LICHFIELD

23. After take-off course was set at 09.38 hrs. the Captain maintaining a position in accordance with visual flight rules to mid-channel (05° 30' W). Some turbulence was experienced for a little while after take-off. Radio contact was maintained with Dublin Tower on 118.1 mcs. and later with Dublin Centre on 118.9 mcs.

24. Shortly after take-off the co-pilot made out the technical log which was completed at 09.46 hrs. and, according to the evidence of Captain Hanley, then checked the fuel quantity although F/O Whyte himself has no clear recollection of doing so.

25. After passing the mid-channel position clearance was obtained from Preston Control to proceed under instrument flight rules at a cruising altitude of 5500 ft., the aircraft ascending to this altitude under visual flight rules.

26. At this stage of the flight flight-conditions were as forecast with broken cloud mainly below the aircraft. The position was checked on several occasions and the record kept on the flight-log.

27. Captain Hanley, in his evidence, states that he checked the fuel quantity when approaching the Wallasey Fan Marker while the co-pilot was out of his seat, obtaining a Gee fix.

(As the accuracy of this check became a matter for careful consideration by the Court, it will be dealt with in Paragraphs 45 and 46).

28. In the vicinity of Whitegate the cloud increased as the meteorological forecast had indicated and the aircraft was flying almost continuously in stratified cloud. Captain Hanley states that he had observed an outside air temperature of -5°C. and a carburettor air temperature of -2°C. According to F/O Whyte's evidence the outside air temperature was -3°C. with a carburettor air temperature of about 0° C. These outside air temperatures were in agreement with the flight forecast. Both pilots gave evidence that only slight rime ice was encountered at any time during the flight. No carburettor hot-air was applied.

29. The Lichfield radio beacon was passed to port at 10.56 hrs. still flying at an altitude of 5500 ft. This was reported to Preston Control who cleared the aircraft to descend to 4500 ft. and to change frequency to Birmingham Approach on 126.9 mcs.

30. Until the Lichfield beacon was passed the aircraft and its engines functioned normally and without any indication of trouble.

d/ THE FINAL PHASE OF THE FLIGHT

31. At 10.57 hrs. the First Officer established contact with Birmingham Approach, making his position report. This was acknowledged by Birmingham who instructed EI-ACF to call overhead at 4500 ft. and gave the actual weather report of Elmdon of 10.55 hrs:- Surface wind 360°/14 kts., visibility 3000 yards, cloud 8/8 at 800 ft, 7/8 at 600 ft., Q.F.E. (aerodrome barometric pressure) 998.2 mbs.

32. Shortly after passing Lichfield the Captain asked F/O Whyte for the expected time of arrival at Elmdon and was given the time of 11.02 hrs. At about 10.58 hrs. Captain Hanley reduced the power setting from 28 inches to 25 inches manifold pressure and commenced the descent.

33. Some time between 10.59 hrs. and 11.00 hrs. the starboard engine cut suddenly without any previous indication or rough-running. Almost immediately (the Captain's estimate being 6 to 7 or perhaps 10 seconds) after the loss of power on the starboard engine, the port engine cut in the same way. The altitude at that time was approximately 5000 ft.

34. At about 11.01 hrs. Captain Hanley told the First Officer to declare an emergency, whereupon F/O Whyte gave Birmingham Approach the following message:- "Emergency, both engines giving trouble, may I commence immediate descent". Birmingham approved an immediate descent to 2500 ft. At 11.05 hrs. Birmingham requested the aircraft's altitude to which the co-pilot replied:- "CF now at 2000 ft., will call you overhead". A little later he called Birmingham:- "CF now 1500 ft. both engines out" and requested a QDM (magnetic course to steer to the station in zero wind conditions) to which Birmingham Homer, who had started taking bearings as soon as the aircraft had established radio contact, answered QDM 030. F/O Whyte then continued giving the altitude until, as he states, the aircraft was just about on the ground.

35. Captain Hanley had not informed his co-pilot of his intentions after the second engine lost power. He, Captain Hanley, was listening to the S.B.A. and did not hear the radio conversation until in the last stages of the descent.

36. At the time of the complete loss of power the aircraft was quite near to Elmdon Airport and at some stage of the descent passed close to the Inner Marker beacon of the S.B.A. As the cloud-base was given as 600 ft. and Captain Hanley was aware of the proximity of H.T. cables and other obstructions near the aerodrome, he decided, when left without power to fly away from Birmingham on a Southerly heading, and the Court accepts in view of his knowledge and experience of the locality, that this decision was justified. The ultimate landing of the aircraft demonstrated that he had chosen one of the few places - if not the only one, apart from the airport - where he could hope to land with any degree of safety.

37. The aircraft descended rapidly through cloud at about 90 kts. and came into the clear at approximately 600 ft. The Captain then saw a wood on a small hill, which he left to port, and to starboard three small fields with trees and rising ground beyond. He put the aircraft down in the first of these at a speed of about 80 kts., wheels and flaps retracted.

38. After touching down the aircraft slid along towards a gap in the far hedge when the Captain noticed a large tree ahead. He put on some right rudder and skidded and skidded the aeroplane through the gap in the hedge, across a road, into the next field where it came to rest with the nose across a ditch. In the skid that followed this manoeuvre the tail hit the tree, the fuselage sustaining severe damage.

PART IV. INVESTIGATION OF THE WRECKAGE

39. The wreckage of the aircraft was examined by Investigating Officers of the Ministry of Civil Aviation of Great Britain, Inspectors of the Department of Industry and Commerce and Engineers of the Company. These examinations disclosed:-

(a) That the aircraft had first touched down in a field approximately 230 ft. above sea level, with wheels and flaps retracted in almost level attitude, had skidded along the ground, finally coming to rest after covering a distance of about 600 ft. The aircraft was extensively damaged due to the impact with the ground and also with a tree. All the flying controls were broken;

(b) The de-icer pump switch was in the "ON" position and the carburettor and windshield de-icer valves were open;

(c) The carburettor hot and cold air intake levers were in the cold air position and not locked;

(d) The port cockpit fuel selector control was set exactly to the Right Main fuel tank and the starboard control was set to the approximate position for the Left Auxiliary tank. As the DC-3 aircraft in the service of the company have no Left Auxiliary tanks a stop is fitted on the cockpit selector quadrants to prevent selector controls being moved to that position. The starboard selector control therefore had been forced over this stop (which was present on the selector quadrants) and was clearly moved to that position by force caused by accidental impact after the aircraft had touched down. This control could not have been manually moved to the position in which it was either before or after the aircraft had come to rest;

(e) The port fuel selector valve was found set exactly in the clicked position to draw fuel from the Right Main fuel tank. The starboard fuel selector valve was found selected to draw fuel from the Right Main tank but very slightly from the clicked position;

(f) The valve actuating cables on the starboard side connecting the drum at the end of the operating torque rod with the drum on the valve were damaged and crushed. The cables were slack. The torque rod was bent. The actuating mechanism was completely disconnected at the spigot. The port cables were connected up and had not been broken in any way but the spar web had been bent and the cables were quite slack.

It seems to the Court most unlikely that a movement by hand of the port cockpit selector after the accident, or accidental impact to the mechanism during the accident, could have given these positions to cockpit selector lever and valve and that the possibility of these consistent positions of cockpit selector and valve having happened by accident, or post accident manual interference, is so remote as to eliminate doubt as to the pre-accident positionsof cockpit selector and fuel valve.

The Court is satisfied that the aircraft was at all times under supervision before examination by the authorised investigators, that no person interfered with any of the mechanism and that the positions of the valves and selectors, as found by the investigators, represented their position on the aircraft coming to rest.

(g) Sixty Imp. gals. of fuel was removed under the investigators' supervision from the Auxiliary tank and the Court accepted that this fairly represents the pre-flight quantity (65 Imp. gals. plus or minus 2) having regard to the

impracticability of drawing out the entire contents of a tank, other than through the drain cock. The outlet pipe of the Right Main tank had been torn off by impact, leaving a large hole, several inches across, at the bottom rear of the tank. No fuel was found in this tank, as would be expected from the nature of the damage, by the time the investigators commenced their investigation. The Left Main tank sustained no material damage but by reason of the impact, the drain cock in the sump of this tank had been pressed into and remained in the open position, allowing any fuel that was in this tank at the time of the accident to drain out.

A flow of petrol from underneath the centre of the aeroplane was observed by several of the witnesses. This was variously described as "a steady flow", "a gush of petrol", a "one inch flow which flowed on to the ground and into the ditch" and "a flow coming from a severed pipe". On consideration of all the evidence of such witnesses and of the investigators, the Court accepted that this petrol was flowing from the Left Main tank through the open drain cock. The Court had not sufficient evidence to enable an accurate estimate to be formed of the total quantity of petrol which thus drained from the Left Main fuel tank but the evidence on this matter was sufficient to establish beyond doubt that at the time of the loss of power this tank contained ample fuel and that, had an engine been drawing from this tank it would not have lost power due to lack of fuel in that tank. If the evidence of Francis C. Delaney, Assistant Chief Engineer of Aer Lingus, of having heard a "dripping" or "cascading" on crossing the fence near the aircraft be interpreted as relating to this petrol flow, and if the rate of flow, as established by the test carried out by the Company, can be taken as representative of the average rate of flow through the drain cock of a DC-3 fuel tank, then this tank would have contained more fuel than could have been possibly left if an engine had drawn fuel from it during the total duration of the flight - but this cannot be regarded as conclusive.

(h) Both the carburettor injection filters and the main fuel filter on which evidence was given were clean and without trace of water. Later examination of the carburettors showed that they contained fuel uncontaminated by water.

(i) The carburettor air intake screens did not show damage characteristic of carburettor icing.

(j) The fuel lines were found to be free from blockage.

(k) The engines and carburettors were stripped and examined at the B.O.A.C. workshops at Treforest. The ignition system, fuel booster pumps and engine driven fuel pumps were tested by Aer Lingus at Dublin Airport.

The tests of carburettors, ignition harness, plugs, ignition master switch, fuel booster pumps, engine driven fuel pumps and inspection of the engines eliminate any possibility of the loss of power having been due to a mechanical failure of any component, or to ignition failure.

PART V. THE PROBABLE CAUSE OF THE LOSS OF POWER

40. Having considered the symptons as expressed by the Captain and First Officer:- absence of rough-running or other previous indication, in each case the sudden and complete loss of power, the drop of the fuel pressure on the only occasion when the fuel pressure gauge was observed after the first engine lost power, the power surges after the booster pumps were put on, the Court is quite satisfied that the cause of the failure of each engine was due to a complete and immediate cessation of fuel supply to the fuel pumps.

41. No suggestion was made by any party that the failure was due to carburettor icing and the Captain himself was satisfied that the engine loss of power did not result from carburettor icing.

42. The only contentions put forward for the cessation of fuel supply were:-

(a) by the Captain, First Officer and Airline Pilots' Association: the possibility of water in the fuel resulting in either blocking the fuel supply by freezing or starving the engine of fuel by displacement of the fuel.

(b) by the Company: a tank or tanks becoming exhausted through mis-selection by the crew so that both engines were running off the same tank.

Contention (a) involved examination of the re-fuelling system at Dublin Airport and the refuelling of the aircraft prior to the flight in question.

The Court was satisfied that the aircraft was on the morning of the 1st of January properly refuelled with petrol of the required grade and free from water contamination. The submission was made that water formed by condensation in the aircraft's tanks prior to her last refuelling, while the aircraft's tanks were much depleted during the period, could have caused water contamination. The Court accepted the evidence of Thomas McGovern that at between 22.00 and 23.00 hrs. he drained off a half-pint of liquid from each of the three tank sumps and that no abnormal quantity of water was found on this check. (The certificate signed by this witness for check 2 shows that he also ran off the fuel filter sumps and this check was formally proved by him in evidence). The possibility of water contamination could only arise from condensation taking place after at the earliest 22.00 hrs. on the night of the 31st of December.

Having regard to the absence of any significant quantity of water, the stage of the flight at which the power failure occurred, the air temperatures prevailing at the time of failure, the absence of water in the carburettors or filters, the Court is satisfied that all possibility of loss of power due to water contamination of the fuel system must be ruled out. Again the symptoms observed at the time power was lost are not characteristic of contamination of fuel by water or restriction of the fuel supply by water.

43. The possibility of water contamination originating in the supply installation or equipment as a cause of the engine failure was also eliminated by the evidence which showed that in addition and prior to the refuelling of EI-ACF on the morning of the 1st of January 1953 three other aircraft were refuelled from the same refuelling vehicle. No trouble was experienced in any of these aircraft. Two further aircraft were refuelled from the same vehicle on the same morning after EI-ACF without complaint.

44. The only possibility of fuel starvation resulting from exhaustion of a tank or tanks was mis-selection of the fuel selector valves in such a way that both engines were running throughout the flight on the same tank. This involves the finding that the crew took off from Dublin with engines drawing from the same tank and in view of the result of the examination of the tanks after the accident that tank must have been Right Main tank.

Non-synchronisation of the fuel selector valves with the cockpit selectors was considered by the Court as a possible cause of both engines drawing from one tank. Evidence before the Court showed that the selecting mechanism was properly assembled. Mr. Newton the British Ministry of Civil Aviation Inspector found on examination that this mechanism had been in proper working order and properly synchronised. This was confirmed by evidence of a flight to London by EI-ACF under the command of Captain Reid on the day previous to the flight in question, and the refuelling figures before and after the said flight. There was also the evidence of a flow test of the fuel system on the last occasion when the selector valves had been serviced and this evidence showed that the fuel system was functioning properly - i.e. check 7 and 8 completed on the 16th December 1952, 86 flying hours previous to the flight to Birmingham.

45. The Court had the positive evidence of the Captain that he moved the selector on the port side to Left Main, and that he made a fuel contents gauge check at Wallasey which indicated to him that the fuel consumption was normal for that stage of the flight; that on the first engine cutting he checked the cockpit fuel selectors; and that he took a fuel contents gauge reading again after the first engine cut and saw a tank dial (he did not know which) which appeared to him to indicate about 50 Imp. gals. It was contended that it did not matter which tank he was reading, as such a content in any one of the three tanks would be inconsistent with the two engines having drawn for so long from any one tank.

This evidence being the evidence of a witness who would not consciously misstate facts and even though it may result from a reconstruction of events (honestly made) cannot be rejected as inaccurate or incorrect unless contrary to unassailably proven facts which would be inconsistent with it. All the evidence was searched for any possibility of an accidental loss of fuel causing the fuel starvation referred to, e.g. by a tank lead or pipe fracture in flight but the facts resist any such possibility. The fuel feed to both engines stopped abruptly and almost simultaneously. Obviously the supply to both engines was cut off at the same time and by the same cause and it has been indisputably established that at least two tanks had ample supply after landing. The Court was reluctantly driven to reject the possibility of any accidental cause operating to the same complete effect and at the same

time to two separate fuel feed sources, if in fact two separate fuel feed sources were being drawn on when power was lost.

46. Such facts call for a more critical consideration of the evidence of Captain Hanley on the cockpit fuel selection check made by him before take-off, the fuel contents gauge readings at Wallasey and after the loss of engine power.

Captain Hanley's evidence was considered as falling short of positive proof for the following reasons:-

The Captain's evidence does not show that he clearly recollects actually seeing the port cockpit selector on the Left Main tank position: it goes no further than that he moved the selector lever and no doubt believed, and still believes, he had moved it to that position. The evidence in regard to the fuel contents gauge reading at or about Wallasey is unconvincing. The Captain is clearly not sure of what tank dials he read and it appeared to the Court as having been no more than a rapid glance as he switched over the gauge selector. The Captain could not afterwards state any reading and it is clear from his evidence that he did not take a reading but merely contented himself with the needle movement which indicated to him at the time that he had what he took to be a normal quantity of fuel for that stage of the flight in whatever tank or tanks were represented by the pointer. The Court was unable to determine whether the Captain at this stage actually observed the dial in relation to one tank, two tanks, or all tanks. The Court had to take into consideration that in a rapid switching movement and reading by the Captain from his position in the left seat and the flicking of the needle, the "upright position" of the pointer which he mentions could be anywhere between 90 and 130. Captain Hanley says that it was a quick check. This check cannot be relied upon for more than an indication that the tanks checked contained fuel.

The fuel contents gauge check made by the Captain on the first engine cutting gave him the impression that whatever tank was then showing on the dial contained about 50 Imp. gals. or thereabouts. Again the evidence cannot be relied upon as giving the quantity of fuel in that tank. In the first place the Captain did not know and did not ascertain whether the gauge selector was turned to the tank supplying the starboard engine. In the second place it was no more than a glance at a time when the Captain was glancing around at every instrument.

At Question 2351, the Captain was asked: "I was "wondering whether you would be in a position to tell the Court "whether you looked at it (the gauge) for the purpose of "checking on the tank supplying the engine which cut. You are "not in a position to say that?" The Captain answered: "No: I "looked at every instrument. I glanced round at each equally "to see if there was anything I could see obviously wrong and "I could not see that anything was indicating anything abnormal".

In reply to Question 2363 the Captain said: "When the "first engine cut and I looked round the cockpit I looked at "the selector and the right selector was on the Right Main and "the left selector was on the Left Main". It is very difficult "to see the starboard cockpit fuel selector from the left seat but apart from this, in the circumstances, seeing the starboard selector to the Right Main tank would at once end interest in the tank selectors because it was the starboard engine which

had lost power and that engine was correctly selected to the Right Main tank: at that stage there would be no purpose in concern with the port cockpit fuel selector. Indeed, this factor may well have turned the Captain's mind completely from fuel exhaustion as a cause of the trouble and it is noted that after the second engine lost power he did not check the tank selection or switch to the Auxiliary tank. The latter tank was never resorted to although at one stage the First Officer stated an intention to try it. One thing is very clear that neither pilot ever thought of fuel exhaustion as a cause of the trouble: they had left Dublin with more than ample supply, had believed the tanks to be properly selected and the first engine to cut was that which was in fact properly selected.

One other thing should be mentioned in this connection: the fuel contents check carried out by the First Officer at 09.46 hrs. This is not recollected at all by the First Officer but the Court feels sure that it was in fact carried out. It is however of no consequence as at that stage of the flight the discrepancy in contents of the tanks would not be sufficiently noticeable on the gauge.

47. Calculation based on the actual conditions of the flight and the time from departure to when the port engine cut, shows that the fuel consumed totals 115 Imp. gals. This was the amount in fact carried in the Right Main tank, so that two engines drawing throughout on that tank would exhaust its fuel at the time when the first engine cut.

Reference may here again be made to the fact that both engines cut practically simultaneously.

48. The Court had evidence of two tests carried out by the Company in which DC-3 aircraft were flown with two engines selected to the Right Main tank until fuel supply failed. There was no material difference in either test between the nature and symptoms of the engine cuts and those experienced in the case of EI-ACF on the occasion of the accident.

49. On the only occasion when the Captain observed the fuel pressure, i.e., after the starboard engine cut, and before the port engine cut, he saw the starboard engine fuel pressure needle flick down to approximately 13 p.s.i. and back to the normal 15 or 16 p.s.i.

The co-pilot stated in evidence that on glancing back to the instrument panel at a late stage in the descent, he saw what he then thought to be the fuel pressure gauge needles lying horizontally to the left. If this were so, it should have indicated to him a failure of the fuel supply. The First Officer now thinks, however, that it was very possible that what he saw was not the fuel pressure gauge but the oil pressure gauge and consequently the Court cannot hold that First Officer Whyte in fact had seen a drop in fuel pressure at any time when remedial action could have been taken.

50. After the second engine cut, the booster pumps were switched on and resulted in immediate if erratic recovery of power described as four surges, over a period of approximately 30 seconds.

51. The steps taken by the pilots after engine cut to remedy the loss of power not being appropriate to fuel starvation as the cause of the trouble, do not, in the failure to recover power, rule out fuel starvation as the cause of the engine cut.

When the first engine lost power, the Captain noticed oscillation of the fuel pressure of the starboard engine. The significance of this symptom was apparently not realised by the Captain. The First Officer on his own initiative applied carburettor hot air, noticing the temperature to rise to about 50°C. He then started to reduce this temperature by moving the controls forward to "cold" but does not remember if he had completed this when the port engine cut and the Captain called for carburettor alcohol which the co-pilot applied. While there was no evidence of carburettor icing at any stage, the Company Regulations prescribing the use of carburettor hot air in the conditions prevailing at the time had not been carried out. There was valuable time lost in attention to possible carburettor icing and deflection of attention from other possible causes of the trouble.

The Captain next called for booster pumps "on" which was followed by the surging already described. From here on there appeared to be a lack of proper and effective co-operation, resulting in failure to diagnose the cause of the trouble and ineffective action to regain power. This failure of co-operation was also probably the cause of ineffective action. The Captain decided to fly South away from the aerodrome and did not tell this to the First Officer; the message given by the First Officer to Birmingham was misleading as it could be, and must have been, interpreted by Birmingham that the aircraft was making a controlled descent to land on the aerodrome. The hostess was not informed in time of the emergency; she should have been told immediately and as a result was in the cockpit at a critical time.

The pilots carried out a check which was confined to mixtures and propeller pitch. On this check the Captain put the mixtures to auto rich, which was correct procedure, and altered the pitch to full fine. This alteration in pitch resulted in an unnecessary increase in the rate of descent and could have resulted in overspeeding if any one of the engines had picked up. On the other hand no possible benefit could be derived from this action. The rate of descent, which the Captain gave at one stage as 1500 feet per minute, could have been kept appreciably lower if the pitch had not been so altered and a still lower rate of descent could have been achieved by putting the pitch to full coarse, which in the circumstances should have been done.

52. The hostess having realised that something was wrong when the engines lost power, went to the cockpit but observing that the First Officer and Captain were busy, returned to the cabin and arranged for the passengers to fasten their seat belts. She then returned to the cockpit noticing then that the "Fasten Seat Belts" and "No Smoking" signs were on. She re-entered the cockpit and asked the First Officer twice what was wrong. He said "Get back, get back; it's all right" Captain Hanley then shouted "Emergency: Get out of the cockpit and into your seat". The hostess left the cockpit, sat down with herback to the cabin bulkhead and demonstrated to the passengers how to brace themselves. The Court concluded that

the aircraft had by then descended to between 1500 feet and 1000 feet. The Court consider that the hostess acted with commendable presence of mind and her care for the passengers contributed in no small way to their escape from injury.

53. It was very forcibly urged that a finding that the fuel starvation was due to mis-selection of the tanks, would involve not only a mistake by an experienced and careful pilot but also a duplication of a series of errors on his part and on the part of the co-pilot; that this would be so highly improbable as to submerge the possibility. In fact, however, (prior to the engine cut) one error only by one man at one time is involved. The co-pilot correctly positioned the starboard cockpit selector. The evidence is quite conclusive that he neither looked at, moved, or checked the port cockpit selector at any time. For reasons already given, the Court could not regard the mid-channel reading of the fuel contents gauge capable of indicating abnormal fuel consumption from one tank. Furthermore First Officer Whyte had himself had a previous experience when flying as First Officer with another Captain of the Company on a flight from Dublin on a DC-3 aircraft, of mis-selection of tanks resulting in the aircraft having flown with both engines drawing from the same tank which remained uncorrected until the Welsh coast had been crossed. The reason given by Captain Hanley for omitting the fuel tank selection test during warm-up and taxying also indicates the possibility of such a mistake by even a careful pilot.

PART VI. CONCLUSIONS

54. The primary cause of the accident was loss of engine power due to fuel starvation. The Court finds that this was caused by selecting the port engine to the Right Main tank to which the starboard engine was also selected.

55. The loss of engine power alone was not the sole cause of the accident, which could have been avoided had the crew diagnosed the cause of the trouble and changed the fuel feed to another tank.

56. The failure to diagnose fuel starvation was probably due to two circumstances: i.e. firstly the lack of co-ordinated effort by the Pilot and First Officer after the engines cut; secondly the knowledge of the crew that ample fuel for the flight was on board and their belief that the engines were drawing from their respective main tanks.

57. The actual forced landing of the aircraft in conditions of low cloud, poor forward visibility and unfavourable terrain was skilfully executed and resulted in the passengers escaping unharmed.

QUESTIONS AND ANSWERS

The Court's answers to the Questions submitted by Counsel for the Minister for Industry and Commerce are as follows:-

1 Q. Did the aircraft EI-ACF have a valid Certificate of Airworthiness when beginning the flight to Birmingham on January 1, 1953?

A. YES.

2. Q. Did the aircraft have a current Certificate of Safety when beginning the said flight?

A. YES.

3. Q. Was the aircraft loaded and trimmed within the limits specified in its Certificate of Airworthiness?

A. YES.

4. Q. Did the aircraft depart from Dublin with sufficient fuel and oil for the proposed flight?

A. YES.

5. Q.(a) Did the aircraft carry sufficient crew?

A. YES.

Q.(b) Were they qualified and adequately experienced to make the flight?

A. YES.

6. Q. Did the failure of any part of the aircraft, its engines or its equipment, cause or contribute to the accident?

A. NO. The loss of power on both engines was not caused, or contributed to, by any failure of any part of the aircraft, its engines, or its equipment.

7. Q. Were there any features of the flight, or symptoms observed, or occurrences during the flight, which were unusual or abnormal?

A. NO. There were none such prior to the loss of power.

8. Q. Did the examination of the wreckage reveal anything of significant abnormality in the aircraft, or its condition?

A. NO.

9. Q. Were the correct operating procedures and practices used by the crew:

(a) before the flight,

(b) during the flight, up to the time of the loss of power of the engines,

(c) after the initial loss of power, up to the time of landing?

A. (a) YES: in the sense that the prescribed procedures and practices had been carried out but an inadvertent mis-selection of

the port cockpit fuel selector was made in the course of the pre-starting cockpit check.

(b) There was a failure by the Captain to observe the Company's Regulation (prescribed in the Pilots' Handling Notes) for the use of carburettor hot air.

(c) No systematic check with reference to the engine instruments was made by either of the pilots, to ascertain the cause of the loss of power. The setting of the pitch of the propellers to fully fine was purposeless, was a wrong procedure - it increased unnecessarily the rate of descent and could have endangered the aircraft had the engines picked up.

10. Q. <u>What was the probable cause of the accident?</u>

A. The primary cause of the accident was the loss of power of both engines due to fuel starvation resulting from the inadvertent mis-selection of the port fuel selector. Notwithstanding this, the accident, in the circumstances, could have been avoided and was ultimately due to the failure by both pilots to diagnose the reason for the loss of power and to take proper remedial action.

11. Q. <u>Was the accident (a) caused or (b) contributed to by any act or omission on the part of any person or party? If so, how, and by what persom or persons or parties?</u>

A. (i) The Captain was solely responsible for the initial error of inadvertently selecting the port cockpit fuel selector to the Right Main fuel tank prior to take-off. This error led to, but need not have resulted in, the accident.

(ii) For the ultimate cause of the accident as given at 10 above, both pilots were responsible.

(iii) Both pilots were equally responsible for the failure to observe a disparity of contents in the fuel tanks en route. This contributed to the accident.

SIGNED: Thomas Teevan

Ritsaert Van Den Honert

Patrick Swan

James Teague.

9th June 1953.

A P P E N D I X I.

Terms of Reference and Appointments of Chairman and Assessors, Court of Inquiry.

Investigation of Accidents (Direction of Formal Investigation) Order, 1953.

WHEREAS it is provided by regulation 10 of the Air Navigation (Investigation of Accidents) Regulations, 1928 (S.R. & O., No. 21 of 1928), that where it appears to the Minister for Industry and Commerce that it is expedient to hold a formal investigation of an accident to which the said Regulations apply, he may by order direct a formal investigation to be held:

AND WHEREAS it appears to the said Minister expedient to hold a formal investigation of an accident to which the said Regulations apply which occurred at Spernall, Warwickshire, England on the 1st day of January, 1953:

NOW, I, SEAN F. LEMASS, Minister for Industry and Commerce, in exercise of the powers conferred on me by the Air Navigation (Investigation of Accidents) Regulations, 1928 (S.R. & O., No.21 of 1928), and of every and any other power me in that behalf enabling, hereby order as follows:-

1. This Order may be cited as the Investigation of Accidents (Direction of Formal Investigation) Order, 1953.

2. A formal investigation shall be held of the accident which occurred at Spernall, Warwickshire, England on the 1st day of January, 1953.

GIVEN under my Official Seal

this 27th day of April, 1953.

(L.S.)

SEAN F. LEMASS

MINISTER FOR INDUSTRY AND COMMERCE.

Appointment of Person to hold a formal inquiry into an accident which occurred at Spernall, Warwickshire, England, on the 1st day of January, 1953.

I, SEAN F. LEMASS, Minister for Industry and Commerce, in exercise of the powers conferred on me by the Air Navigation (Investigation of Accidents) Regulations, 1928 (S.R. & O., No. 21 of 1928), and of every and any other power me in this behalf enabling, hereby appoint Thomas Teevan, Senior Counsel, of 3, Eglinton Road, Donnybrook, Dublin, to hold the formal investigation of the accident which occurred at Spernall, Warwickshire, England, on the 1st day of January, 1953.

GIVEN under my Official Seal
this 4th day of May, 1953.

L.S. (Sgd.) SEAN F. LEMASS

MINISTER FOR INDUSTRY AND COMMERCE.

Appointment of Persons to act as Assessors in the formal investigation of an accident which occurred at Spernall, Warwickshire, England on 1st day of January, 1953.

I, SEAN F. LEMASS, Minister for Industry and Commerce, in exercise of the powers conferred on me by the Air Navigation (Investigation of Accidents) Regulations, 1928 (S.R. & O., No. 21 of 1928), and of every and any other power me in this behalf enabling, hereby appoint -

Commandant Patrick Thomas Swan,
Air Corps, Baldonnel, County Dublin,

Commandant James Teague, B.E., D.I.C., A.F.R.Ae.S.,
Air Corps, Baldonnel, County Dublin,

Captain Ritsaert van den Honert,
KLM (Royal Dutch Airlines),

to act as assessors in the formal investigation of the accident which occurred at Spernall, Warwickshire, England on the 1st day of January, 1953.

GIVEN under my Official Seal this
4th say of May, 1953.

(L.S.) (Sd.) SEAN F. LEMASS

MINISTER FOR INDUSTRY AND COMMERCE.

APPENDIX II.

SITTINGS.

The Court of Inquiry held Public Sittings in the Four Courts, Dublin, on the 19th, 20th, 21st, 22nd, 23rd, 26th, 27th, 28th, 29th and 30th days of May, 1953, and on the 1st day of June, 1953. The members of the Court paid two visits to Dublin Airport and there inspected D.C.3. Aircraft.

A P P E N D I X III.

APPEARANCES.

Mr. A. O'Keeffe, S.C. and Mr. Brian Walsh (instructed by The Chief State Solicitor) appeared for the Minister for Industry and Commerce.

Mr. G. D. Murnaghan S.C. and Mr. C. Maguire (instructed by Mr. J. S. O'Connor) for Aer Lingus Teóranta.

Mr. R. McGonigal S.C. and Mr. S. Heavey (instructed by Mr. George McGrath) for Captain T. J. Hanley.

Mr. C. Campbell S.C. and Mr. J. J. L. Devlin (instructed by Messrs. Elyan Seligman & Co.) for First Officer Patrick J. Whyte).

Mr. S. Breathnach (instructed by Messrs. Thos. Early & Son) for four Members of the ground staff, Aer Lingus Teóranta, Messrs. Laurence Sumner, Thomas McMorrough, William Bagnell and Robert Lyster.

Mr. C. N. Ferguson, National Organiser of the Workers' Union of Ireland, represented the Irish Airline Pilots' Association.

Mr. G. R. Mack represented the Government of Great Britain and the British Ministry of Civil Aviation.

E. S. Fitz-Simon (instructed by Messrs. Barrington & Son) for Irish Shell, Ltd.

APPENDIX IV.

Persons Who Gave Evidence on Oath Before The Court of Inquiry.

1.	Laurence O'Brien,	Senior Maintenance Engineer, Aer Lingus Teóranta.
2.	Thomas McMorrough,	Aircraft Inspector, Aer Lingus Teóranta.
3.	Laurence Sumner,	Aircraft Inspector, Aer Lingus Teóranta.
4.	William Dillon,	Traffic Clerk, Aer Lingus Teóranta.
5.	Edward Campbell,	Traffic Assistant, Aer Lingus Teóranta
6.	George McFeely,	Air Fuel Operator, Irish Shell, Ltd.
7.	Matthew McCormick,	Air Fuel Operator, Irish Shell, Ltd.
8.	Hubert Lyster,	Mechanic, Aer Lingus Teóranta.
9.	John Logue	Traffic Clerk, Aer Lingus Téóranta.
10.	Declan Lonergan,	Air Traffic Control Officer, Dublin Airport.
11.	Reginald Frank Prior,	Approach Control Officer, Elmdon, Birmingham.
12.	Roy Massey Hutson,	Civil Engineer, Passenger on Aircraft E l. -ACF at time of accident.
13.	Noel B oylan,	Operations Officer, Aer Lingus Teóranta
14.	Philomena McCloskey,	Air Hostess, Aer Lingus Teóranta.
15.	Randolph Gibbons,	Farmworker, Spernall.
16.	Sergt. John A. Thomas,	Warwickshire Constabulary.
17.	Sergt. John P. Greethead,	Warwickshire Constabulary.
18.	Morley Howard Freeman,	Senior Scientific Officer, Meteorological Office, Air Ministry, England.
19.	Capt. Gordon Wade,	Chief Instructor, Air Lingus Teóranta.
20.	Capt. Thomas Hanley,	Pilot, Aer Lingus Teóranta.
21.	Patrick J. Whyte,	Pilot (First Officer), Aer Lingus Teóranta.
22.	Eric Newton, M.B.E., A.R.Ae.S.	Accidents Investigation Branch, Ministry of Civil Aviation, London.

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23.	Francis C. Delaney,	Asst. Chief Engineer, Aer Lingus Teóranta.
24.	Brendan Cannon,	Acting Station Engineer for Aer Lingus Teóranta at Northolt Airport.
25.	Matthew Brocklebank,	Senior Foreman, Aer Lingus Teóranta.
26.	Capt. John Reid.	Pilot, Aer Lingus Teóranta.
27.	Capt. Richard Seigne,	Pilot, Aer Lingus Teóranta.
28.	Arthur Joseph Walls, B .E., Grad.R.Ae.S.	Development Engineer, Aer Lingus Teóranta.
29.	Thomas McGovern,	Mechanic, Aer Lingus Teóranta.
30.	John Butler,	Sub-Inspector, Aer Lingus Teóranta.
31.	Michael Kenny,	Inspector, Aeronautical Branch, Department of Industry & Commerce.
32.	William Patrick Ward,	Senior Maintenance Engineer, Aer Lingus Teóranta.
33.	Stephen Mullinder,	Associate Member of the Society of Licensed Aircraft Engineers, England.
34.	David O'Brien,	Chargehand, Aer Lingus Teóranta.
35.	Frank Smith,	Mechanical Engineer, Irish Shell Ltd.
36.	Ambrose Lawlor,	Fuel Supervisor, Dublin Airport, for Irish Shell Ltd.
37.	William Sinclair Ault, B.A. (Oxon.)	Chemist, Technical Department, and Chief Technical Adviser to Shell Mex & B.P. Ltd., and to Irish Shell Ltd.

APPENDIX V.

DOCUMENTS AND EXHIBITS PUT IN EVIDENCE

No.	Date	Document or Exhibit
1.	1st March, 1946.	Certificate of Registration of Aircraft El -ACF.
2.	20th February, 1952	Certificate of Airworthiness of Aircraft El -ACF.
3.	1st January, 1953.	Flight Plan of Aircraft El -ACF. Dublin to Birmingham.
4.	1st January, 1953.	Load and Trim Sheet, Aircraft El-ACF.
5.	1st January, 1953.	Passenger Manifest, Aircraft El -ACF.
6.	1st January, 1953.	Cargo Manifest, Aircraft El-ACF.
7.	12th December, 1952.	Prepared for Service Form, Aircraft El-ACF.
8.	---	Aer Lingus Pilots' Check List, D.C.3. Aircraft.
9.	1st January, 1953.	Certificate of Safety for Flight, Aircraft El-ACF.
10.	1st January, 1953.	Technical Log, Aircraft El-ACF.
11.	1st January, 1953.	Department of Industry and Commerce Meteorological Service Flight Weather Forecast.
12.	7th January, 1953.	History of Aircraft El-ACF.
13.	31st December 1952 and 1st January, 1953.	Maintenance Forms, Aircraft El-ACF.
14.	7th January, 1953.	Test Report on Booster Pumps Motor Serial No.1462, Pump Serial No.PEW. 30138.W and Motor Serial No. 7508, Pump Serial No. PEA. 446.W. removed from Aircraft El-ACF.
15.	9th January, 1953.	Test Report on Pesco Fuel Pumps - Type 2 PR.600.CWX1. Serial Nos. PEA. 1838. W. and PEA. 454. W.
16.	14th January, 1953.	Test Report on Magneto Control Switch type Bendix Scintilla A-20 removed from Aircraft El-ACF.
17.	13th and 19th January, 1953.	Reports on Pressure Tests made with Booster Pumps, Engine Pumps and Carburettors removed from Aircraft El-ACF.
18.	1st January, 1953.	Copy of Written Log, Birmingham Air Traffic Control (in code).
19.	1st January, 1953.	Copy of Written Log, Birmingham Air Traffic Control (decoded).

No.	Date	Document or Exhibit.
20.	1st January, 1953.	Typescript of Speech Recordings, Birmingham Air Traffic Control with Aircraft El-ACF.
21.	1st January, 1953.	Fuel Loading Forms, Aircraft El-ACF.
22.	---	Five Photographs - Views of Wreckage of Aircraft El-ACF.
23.	---	Photograph of Instrument Panel D.C.3. Aircraft.
24.	---	Photograph of Fuel Tank Selector Valves, Aircraft El-ACF.
25.	---	Photograph of Fuel Quantity Gauge and Fuel Pressure Gauge, Aircraft El-ACF.
26.	---	Aer Lingus Pilots' Handling Notes. Chapter 2, Sects. 5 & 12, Page 3.
27.	15th February 1951.	Aer Lingus Aircraft Operating Instructions, Page 1/4. (Serial No. 21/50/(0) and 15/12/51 Page 5/7, Serial No. 18/51 (0).
28.	3rd January, 1953.	Weather Aftercast Prepared by Meteorological Office, Ministry of Civil Aviation, England.
29.	1st January, 1953	Extract of Dublin Air Traffic Control Tower recordings of communications with Aircraft El-ACF.
30.	1st January, 1953.	Extract of Dublin Air Traffic Control Centre recordings of communications with Aircraft El-ACF.
31.	1st January, 1953.	Dublin Air Traffic Control Flight Plan, Aircraft El-ACF (in code).
32.	1st January, 1953.	Dublin Air Traffic Control Flight Plan, Aircraft El-ACF. (decoded).
33.	---	Sketch of Scene of Accident to Aircraft EL-ACF. prepared by Ministry of Civil Aviation, England.
34.	27th to 31st December, 1952.	Details of Fuel Loads of Aircraft El-ACF. for the 27th, 28th, 29th, 30th and 31st days of December, 1952.
35.	16th to 18th December, 1952.	Aer Lingus File on Flight Tests and Maintenance Checks on Aircraft El-ACF. from 16th to 28th December, 1952 (75 sheets).
36.	25th November, 1952.	Journey Log Book Aircraft El-ACF from 25th November 1952.
37.	---	One Airframe, Engine and Two Propellers (2) Log B ooks Aircraft El-ACF.
38.	---	Diagramatic layout of refuelling system of Irish Shell Ltd. at Dublin Airport.

No.	Date	Document or Exhibit.
39.	---	Fuelling Vehicle Daily Log Sheet.
40.	-- ---	Water Dip Test Book - Records of water Dip, Filter, Dripcap and Earth Wires, Tests in Storage Tanks and Fuelling Vehicle of Irish Shell Ltd. at Dublin Airport.
41.	---	Two Photographs of Pressure Gauges in Instrument Panel Aircraft El-ACF.
42.	8th November, 1951.	Airline Transport Pilot's Licence No.32. held by Capt.Thomas J.Hanley, dated 8th November 1951, covering four periods of validity expiring 13th November, 1953.
43.	3rd March, 1952.	Flight Radio Operator's Licence No.88 held by Capt.Thomas J.Hanley, dated 3rd March 1952, covering two periods of validity expiring 5th November 1953.
44.	1st January, 1952.	Senior Commercial Pilot's Licence No.7. held by Patrick Whyte, dated 1st January 1952 covering 2 periods of validity expiring 23rd April 1953.
45.	29th December,1952.	Airline Transport Pilot's Licence No.66 held by Patrick J. Whyte dated 29th December 1952 covering period expiring 15th April 1953.
46.	---	Fuel Contents Gauge from Aircraft El-ACF.
47.	---	Fuel Pressure Gauge from Aircraft El-ACF.
48.	---	Fuel Selector Valve (Starboard) from Aircraft El-ACF.
49.	---	Fuel Selector Valve (Port) from Aircraft El-ACF.
50.	---	Specimen Fuel Selector Valve. D.C.3 Aircraft.
51.	---	Specimen Oil Pressure Gauge, D.C.3 Aircraft
52.	---	Specimen Tank Drain Cock, D.C.3.Aircraft.
53.	---	Specimen Petrol Tank Sump, D.C. 3 Aircraft.
54.	---	Valve Spigot, D.C.3 Aircraft.
55.	---	Sectional Model of Aircraft Carburretor, D.C.3 Aircraft.
56.	---	Fuel Tank (Port)from Aircraft El-ACF.
57.	---	Tape Recording of No.20 above - played over in Open Court on Monday 1st June, 1953.