AAIU Report No: 1998-001
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Operator:	Emerald Airways
Aircraft Type:	HS 748-2A
Nationality:	British
Registration:	G-AYIM
Place of Accident:	Stand 55, South Apron, Dublin Airport.
Date & Time (UTC):	6th July 1996 at 0106 hrs.

Synopsis

The accident was notified to the Air Accident Investigation Unit (AAIU) by Dublin Air Traffic Control at 0110 hours on the 6 July 1996. An AAIU Inspector arrived on scene at 0200 hours on the same day.

The aircraft, which was on a scheduled cargo flight from Liverpool, landed on Runway 28 at Dublin Airport at 0100 hours and taxied to Stand 55 on the South Apron. Having brought the aircraft to a stop, the cockpit crew commenced their shutdown drills, which included a 30 second temperature stabilisation with engines at idling speed. During this time the marshaller approached from in front of the aircraft and chocked the nose wheel. Having chocked this wheel, a witness observed the marshaller walking backwards in an arc, giving a thumbs-up to the cockpit as he did so. Seconds later, the marshaller came in contact with the idling port propeller and received fatal injuries to his head. None of the witnesses present observed the actual propeller strike to the marshaller.

1. Factual Information

1.1 History of the accident

The aircraft took-off from Liverpool Airport at 0014 hours on a scheduled cargo flight to Dublin. The weather at Dublin was good, with 10 km visibility, clear skies, temp 10°C and a wind of 300/07 kts. After landing on Runway 28 at 0100 hours, G-AYIM was cleared by ATC back along the parallel taxiway, towards the South Apron for Stand 55.

Stand 55 is one of two Stands approved for self-manoeuvring operations on the South Apron and requires a right hand 180° turn onto the Stand, **(Fig 1)**.

On entering the South Apron along the taxiway markings, the co-pilot, who was occupying the starboard seat, observed a marshaller in his 3 o'clock position located on Stand 55. The marshaller, who was facing in a north-easterly direction, had the aircraft chocks placed at his feet and slightly to the right of the stand hammerhead. It was noted at the time by the co-pilot, that the marshaller had no marshalling wands. As G-AYIM commenced its right hand turn towards the stand, the co-pilot observed a ground operative, (hereafter referred to as A) approaching the marshaller with wands in his hands. A brief discussion took place between the two individuals, followed by the marshaller handing over his ear defenders to A and walking away in an easterly direction. A then assumed the duties of marshaller and proceeded to marshal G-AYIM onto the stand. Communications between the flight deck and A were by means of wand signals only.

Note: *As can be best determined, the next intended movement of the A after successfully chocking G-AYIM, would have been to look after the needs of the flight crew if required, and then to await the arrival of a second aircraft, (The Cliften) which was not due in for a further 55 minutes.*

A number of other ground operatives were positioned off the port wing tip and behind the equipment restraint line, as G-AYIM made its final right hand turn towards A. On receiving the stop signal from A, the Captain brought the aircraft to a halt. At the same time the co-pilot gave a thumbs up to A, applied the parking brake and retarded the fuel cocks to the idle position. A in turn signalled back to the crew with a thumbs-up and this was the last time that the Captain and the co-pilot observed the movements of A. The cockpit crew commenced the pre-shutdown checks, which included among other things, a 30 second temperature stabilisation with engines at idling speed. After the 30 seconds period, the co-pilot closed the HP cocks on both the engines and almost immediately after that, a loud bang was heard by the crew.

Initially they thought that the front door had been opened or that a vehicle had struck the aircraft. However when the Captain looked out of his port window, he saw a body under the port wing, lying outboard of the still rotating propeller. The time of the strike was estimated to be 0106 hours. The anti-collision beacon lights were still on and rotating at the time of the accident.

As a number of ground operatives ran to the aid of A, the aircraft Captain radioed Dublin Tower, informed them of the situation and requested an ambulance. An airport police car, which was in the area at the time arrived almost immediately, followed promptly by an airport fire service ambulance.

A member of the airport police attempted to confirm vital signs and administer first aid. However, this proved difficult, due to the extent of the injuries. A was then put on a stretcher and brought to nearby Beaumont Hospital were he was pronounced dead on arrival.

1.1.2 Eyewitness recollections

Personnel who were on or in the general vicinity of the stand on the night in question were interviewed over a number of days after the accident. The accounts of where each person and their related equipment was positioned at the time of the accident varied slightly, therefore the positions given in **(Fig 2)** are deemed to be their most probable positions.

Prior to the arrival of G-AYIM, witness No 1 had made his way out to Stand 55 in order to marshal in the aircraft. He noted the following items of equipment were positioned at the equipment assembly point:- one tug attached up to a ground power unit (GPU), two conveyors and a number of dollies (wheeled trollies). Witness No 1, who was now positioned on the stand hammerhead, observed two company tugs, with two persons on each, arrive at the equipment assembly point. Two of the dollies were then connected up in turn to each of the tugs.

A short time later, the company courtesy car arrived and parked to the left of the assembled equipment. Witness No 2, who was a passenger in the car, stated that A had driven the car out to the stand. On arrival, A informed him that he had been assigned marshalling duties for the week by the supervisor.

He left the car with both marshalling wands in his hand, and made his way over to witness No 1. On arrival, witness No 1 asked him for the wands, however he was informed by A that he was told to do the marshalling for the week and thus took over the duty.

Witness No 1 handed over his ear defenders to him and made his way back to the equipment assembly point. Having marshalled the aircraft to a halt on the stand, A was observed by witness No 2 (now beside the car) walking in along the port side of the aircraft and placing one chock to the front and one to the rear of the nose wheel.

Witness No 2 (walking from the car to the first conveyor) stated that he saw A standing up from the rear chock, walking backwards in an arc and giving the thumbs-up in the direction of the port cockpit window. As witness No 2 mounted the first conveyer, he heard a loud bang, he turned in the direction of the port engine and observed A falling to the ground.

Witness No 3 drove a tug and dolly in behind the port wing as A was chocking the nose wheel. Both aircraft engines were idling at the time. In discussions with this witness, he believed that the positioning of his equipment behind the port wing, obstructed the direct line of vision for the majority of the personnel as they moved towards the aircraft from the equipment assembly point.

As a result of this, no one actually witnessed the final movements of A. This particular witness last saw A chocking the nose wheel. On turning to check the whereabouts of the GPU, he heard a bang, he turned and saw A fall to the ground.

Witness No 4 (on tug with GPU) and witness No 5 (beside GPU) both saw A down at the nose wheel. They were next alerted to the position of A when they heard what they described as three loud thuds.

Witness No 6 (on second conveyor) heard a loud bang and observed A in a prone position up against the propellers facing backwards and then falling to the ground.

Witness No 7 (on second tug with dolly) had his back turned away from the aircraft and he did not observe anything until he saw his colleagues running to assist A.

Witness No 8 (supervisor walking towards stand) did not observe anything having arrived on the stand minutes after impact.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	-	-	1
Serious	-	-	-
Minor/None	2	-	

1.3 Damage to aircraft

Slight blade tip damage to props on No 1 engine.

1.4 Other damage

None.

1.5 Personnel information

1.5.1 ***Commander:*** Male, aged 62 years

Licence: Valid Airline Transport Pilot's Licence

Aircraft rating: HS-748

Instrument Rating: Renewed 19 April 1996

Medical certificate: Class one renewed 27 February 1996

Flying experience: Total flying: 15,000 hours(108 on type)

Last 90 days: 108 hours
Last 28 days: 41 hours

Duty Period to Time of Accident: 5.35 hours
Rest Period Prior to Duty: 11.10 hours

1.5.2 ***Co-pilot:*** Male, aged 36 years

Licence: Valid Commercial Pilot's Licence

Aircraft rating: HS-748

Instrument Rating: Renewed 15 May 1996

Medical certificate: Class one renewed 23 November 1995

Flying experience: Total flying: 950 hours(75 on type)
Last 90 days: 75 hours
Last 28 days: 30 hours

Duty Period to Time of Accident: 5.35 hours
Rest Period Prior to Duty: 11.10 hours

1.5.3 ***Ground operative:*** Male, aged 36 years

Experience: The deceased was employed with the ground handling company since 25th Sept. 1995, a total of nine months. Initially, he was employed on warehouse duties. On the 25th Dec 1995, he suffered a knee injury while at work in the warehouse, and was on sick leave until the 11th Mar 1996, a total of 11 weeks. On returning to work from sick leave, he was mainly employed on warehouse duties. However, for a period leading up to the accident, the deceased carried out a number of ramp duties, which included the marshalling of aircraft. There are no Company records to indicate the division of time spent between warehouse and ramp duties. However a work colleague estimated that the deceased worked approximately 70% of his time in the warehouse.

Duty/Rest Period: The shift period for the deceased had commenced at 2300 hours on the evening prior to the accident. Prior to that, he worked two shifts of 2300 hours to 0700 hours and prior to that he had two days annual leave.

1.6 Aircraft information

The HS 748 2A is a low-wing cantilever monoplane with a turboprop engine mounted on each wing in a nacelle, that also incorporates a main landing gear bay. The four bladed propellers are of constant-speed/fully-feathering type, and rotate in a clockwise direction when viewed from the front with a normal ground idle speed of 650 rpm approximately. The diameter of the rotating propeller is 3.66m with a ground clearance of approximately 0.61m with the aircraft static on its landing gear. The distance from the fuselage to the inner propeller tip is 0.61m, to the propeller spinner 2.44m and to the outer propeller tip 4.27m, **(Fig 3)**.

1.7 Meteorological information

Not relevant

1.8 Aids to navigation

Not relevant

1.9 Communications

Not relevant

1.10 Aerodrome information

1.10.1 Apron surface condition

Stand 55 is contained within a newly constructed area of the South Apron. The surface is made of a serrated cement finish and provides a high level of grip. The surface as inspected one hour after the accident, was dry and free from fuel and oil spills. There was nothing to indicate at the time that the surface condition constituted a hazard or contributed to the accident.

1.10.2 Apron lighting

It was night at the time of the accident, and the normal ramp lighting was on and serviceable at the time. When asked about the quality of the lighting, the majority of the ground operatives stated that the lights provided an adequate level of illumination on the stand.

1.10.3 Apron security video footage

A request was made to the Airport Police to recover the south apron security video footage to see if the camera had scanned Stand No 55 at the time of the accident. No footage was recovered, as the system had run out of recording tape a number of hours prior to the accident.

1.11 Flight Recorders

Fitted, but not relevant

1.12 Wreckage and impact information

Not relevant

1.13 Medical and pathological information

A post mortem examination revealed no medical condition that could have any bearing on the accident.

1.14 Fire

Not relevant

1.15 Survival aspects

Not relevant

1.16 Tests and research

None

1.17 Organisation and management information

1.17.1 Ground Handling Company

In discussions with the handling company, they stated that operational procedures at their Dublin base, generally follow the operating procedures that are in force for the handling group as a whole, with appropriate variations if local requirements so dictate. These operating procedures are incorporated within the training programme and were in force at the time of the accident. Each relevant member of staff is issued with a copy of the operating procedures. The Training Programme is made up of three elements, classroom training with a unit trainer, practical training of each skill required, and the issue of an "Induction Pack" to act as an aide-memoire and continuing reference for all aspects of the required duties.

With regard to the safety monitoring system in place at the time of the accident they stated that working teams are structured so that a team leader would monitor the day to day performance of the members of that team. The team leaders are answerable to supervisors, duty managers and ultimately, the operations manager. Where team members are considered to be weak or inadequate in any respect of their job function, they will be assigned for re-training. They noted that if a problem was sufficiently serious, there was always the measure of invoking the Company's disciplinary procedure.

1.17.2 **(UK) Civil Aviation Authority Requirements for Air Operators Certificate (AOC) Holders**

The Operator held a UK AOC (No 599), which was issued and regulated by the UK Civil Aviation Authority, (UK CAA). CAP 360, Part 2 details the arrangements required for AOC Holders with regard to Maintenance Support, including the contracting out of ground handling. It requires that a written agreement be in existence, and details the tasks to be performed on behalf of the operator by the handling agency. Chapter 3 Part II para 4.2 notes that the standard International Air Transport Association (IATA) Ground Handling Agreement (AHM 810) provides a general acceptable basis for such an agreement.

Para 4.3 notes that..... *" It is the responsibility of the (aircraft) Operator or his principal maintenance contractor to ensure that the continuing performance of the ground handling contractor is such as to ensure safe operations of the operator's aircraft, and that necessary training has been performed".*

In turn this is monitored by the operator's maintenance organisation quality programme as per Chapter 6 Para. 1.8(d). The responsibility for monitoring compliance with the requirements of CAP 360 Part II is monitored by the AOC Maintenance Section (AOCM) of the CAA, which forms part of the Flight Operations Department. Through AOCM, the UK CAA has to satisfy itself that the operator has arranged support arrangements as per the foregoing. The CAA does not carry out any direct monitoring of an operator's performance of this function.

The CAA stated that the AOC holder in this particular case discharged their responsibility in respect of the CAP 360 Part II requirements through their contracted maintenance organisation, which is a UK based company (Approval Ref. CAA 00008).

The maintenance agreement between the maintenance organisation and the AOC holder, dated the 12 August 1993, requires the maintenance contractor to *"provide quality audits of all the operator's stations, bases and nominated third party maintenance organisations usually at 6 month intervals, but variable according to results obtained"*. Dublin Airport however was not listed in the AOC holders Engineering Manual as a line station for maintenance purposes. The maintenance organisation, confirmed that they were not responsible for the continuing performance of the AOC holders contracted handling agent at Dublin Airport, but solely for the engineering requirements in support of the operators AOC.

If the AOC holder had nominated Dublin Airport as a line maintenance station, then Surveyors from AOCM would carry out audits of that station for compliance with JAR 145 and CAP 360 Part II requirements, including ground handling.

The AOC holder had no written agreement with the Dublin Airport ground handling company to comply with the requirements of CAP 360 Part II, Chapter 3 para 4.3, nor had they any input into the procedures or training standards.

1.17.3 Apron safety, regulation, monitoring and enforcement (Ireland)

Responsibility for the control of apron surface traffic rests with the Airport Operator. As stated in the Airport Directive No 2, '*In pursuance of this responsibility the Airport Authority will regulate the parking of aircraft, and the movement of vehicles, equipment and pedestrians on the apron'*.

Section 2.0 of the Directive; "Pedestrians on the Apron", categorises the different pedestrians and includes at 2.1 (b) '*Other airport staff, such as Operations, Technical, etc., as necessary in the course of their work'*.

Section 5.2.1 of the Directive; "Marshalling", states that, *"it is the responsibility of the Airport Authority to provide marshalling of aircraft at Dublin Airport. Marshalling services may be delegated to a designated Handling Agent or contracted Handling Agents"*.

Ground handling Companies/Agents are not regulated by the IAA or by the Airport Operator. While the Airport Operator had no direct input into the actual training standards or procedures of the handling agency, the training standards, apron procedures and compliance with Airport Directives and National Regulations were covered under Annex A, Ground Handling Services of the IATA standard handling agreement. A formal agreement between the Airport Operator and the Ground Handling Company was executed on the 20th June 1995.

Monitoring and policing of ground handling companies at Dublin Airport is carried out by the Airport Operator on an on-going basis. If any breaches of ramp safety are observed, they are brought to the attention of the offending company and the relevent penalties are imposed.

1.17.4 Health and Safety Authority (HSA)

The body with overall responsibility for ensuring health and safety in the Irish work place is the Health and Safety Authority (HSA). As a state sponsored body it monitors compliance with legislation and can take enforcement action including prosecutions.

The most recent items of legislation are, the Safety, Health and Welfare at work (General Application) Regulations 1993 and Safety, Health and Welfare at Work (Miscellaneous Welfare Provisions) Regulation 1995. The principle legislation is the Safety Health and Welfare at Work Act, 1989.

While the HSA does not as a rule become involved in the regulation of aircraft operations in view of the IAA responsibilities in this area, they would be concerned that any other persons employed incidental to the operation of an aircraft should have the full protection of the type of provisions provided for in the safety and health legislation. These provisions include the very important accident prevention concepts of identifying hazards, assessing risks, having in place a consultative mechanism and effective control measures.

Under Section 34 of the Act, (Powers of Inspectors), Health and Safety Authority Inspectors may visit work places without notice and have the right to talk to employees and safety representatives.

Over 12,000 inspections are carried out each year by Inspectors, including investigations of fatal and other accidents in discharge of the Authority's statutory functions. In relation to the particular handling company involved in this accident, the HSA carried out a limited inspection i.e. confined to warehouse and check-in areas on the 9th of February 1995. An "Improvement Notice" was served on the Company on the 21st February 1995, for failure to produce a "Safety Statement" when requested.

1.17.5 International Air Transport Association (IATA)

The development and adoption of standards for airport handling arose in Europe where an overlap of the networks of many different airlines resulted in the necessity for airlines to arrange handling contracts with each other. The standards developed under the auspices of IATA represent the most practical basic handling procedures.

These procedures have been established as the most suitable for handling passengers and their baggage, cargo and mail and are those most acceptable to the airlines airport handling staff. While the Ground Handling Agreement makes reference to the types of services to be provided, it does not refer to any minimum staff training requirement nor does it state how or when these procedures will be carried out or monitored.

1.18 Additional information

1.18.1 Licensing of Aerodromes (Ireland)

State Airports, established by the Minister for Industry and Commerce under Section 37 of the Air Navigation and Transport Act, 1936, do not require to be licensed under Article 4, of S.I. No. 291 of 1970 Air Navigation (Aerodromes and Visual Ground Aids) Order 1970.

Non-State Airports, engaged in commercial operations, must be licensed and regulated by the Aerodrome Safety Section of the Irish Aviation Authority (IAA). The Corporate Standards Inspectorate (CSI) of the Airport Operator carries out a twice yearly inspection on the three State Airports, Dublin, Cork and Shannon and furnish copies of their reports to the Irish Aviation Authority. The inspections carried out by the CSI are in turn audited by the Personnel Licensing Standards Department (PLSD) of the IAA.

1.18.2 Training and Training Records

There was no record of the deceased having completed a formal ground handling training course on entry to the company. However a number of proficiency sheets relating to the deceased and a number of other personnel, were presented by the handling company. The deceased's name was first to appear on each sheet.

The first Training Record entitled, "Equipment Skills - Cargo Requirements - Ramp", recorded that the deceased was qualified in a number of ramp disciplines, including aircraft marshalling. The training officers name was printed on the bottom of the sheet, but it was undated.

The second Training Record entitled, "Mandatory Job Skills - Warehouse", also recorded qualification for the deceased in a number of warehouse skills. This sheet, while dated 20/05/96 13:45 hours, was unsigned.

Two of the witnesses interviewed were named on the above mentioned sheets. They both joined the company prior to February 1996, and each stated, when interviewed, that they did not receive any formal training on entry and generally had learned their trade by watching others. Personnel joining post February 1996, received a five day induction course.

1.18.3 Appointment of Training Officer

In February 1996, the company appointed a training officer, with responsibility for induction training of newly recruited personnel, refresher training and the on-going monitoring of safety standards.

The training officer developed a 5 day (new recruit) induction pack, which consisted of both practical and theoretical ground handling training. Due to the high turnover of personnel in the company in the months leading up to the accident, the training officer was mainly engaged in new recruit training and thus was afforded little time for refresher training and/or on the job safety checking.

He stated that in general, training was done subject to the availability of personnel, ground handling equipment and aircraft. He confirmed, that the deceased did not complete a formal induction course on entry to the company.

When asked if any training had been given to the deceased, the training officer stated that he himself had completed some ad hoc on-the-job training with the deceased when they were rostered on the same night shift. This training had consisted mainly of showing the apron safety lines and use of the different equipment. The deceased was employed permanently on night shift duties.

The deceased did receive a pocket sized, company safety booklet entitled, "Think Safety" and was issued with a copy of the "Induction Pack", on his return from sick leave. In the opinion of the training officer, he believed that the deceased was aware of the contents of both documents. His general impression of the deceased, was that he was a quiet, solid and enthusiastic individual, with a good attitude and was very much liked by the rest of the crews with whom he had worked.

1.18.4 **Think Safety Booklet**

This booklet was issued to the deceased and to members of staff who are employed in the warehouse and/or on apron duties, and covers such areas as Safety on the Apron, Aircraft, Cargo Warehouses, Driving, Fire, Freight, Manual handling, Workshops, and Offices.

Its purpose is to emphasize to each employee the more serious hazards they will encounter during their daily work and to assist them in being more safety conscious.

Under the section, "Aircraft", the booklet makes reference to the dangers of the intake of jet engines and propeller-driven aircraft. With specific reference to the hazard of propeller-driven aircraft it states,*".....fully rotating blades are not very visible. Keep well away until they are stationary, then do not walk through or close to a propeller - even when it is stationary - it could rotate at any time".* The section finishes by saying, *".....staff should only operate equipment and provide handling assistance when recognised training has been given and satisfactorily completed".*
Under the section "Driving", it states, *"....never drive within the hazardous area behind an aircraft when its anti-collision beams are operating".*

1.18.5 **Induction Pack**

The Induction Pack, which contains procedures for warehouse and apron duties, is issued to newly recruited personnel. Under the section relating to "Meeting an aircraft on arrival", it states; *"....Once the aircraft is stationary, stay back until engines have stopped, beware of the suction on a jet engine which could suck a person into it - This has happened especially with the new modern engines which are more powerful and a lot quieter. STAY WELL BACK FOR AT LEAST 30 SECONDS AFTER ENGINES HAVE BEEN SWITCHED OFF. LOOKOUT ALSO IF IT IS A PROPELLER AIRCRAFT, WAIT UNTIL PROPELLERS HAVE COME TO A HALT.*

When it is safe, chock main wheels. Resting the chocks against the wheels to prevent aircraft rolling when the flight deck release aircraft brakes, advise the flight deck this has been done".

Under the section, "CAREFUL DRIVING ON THE RAMP", it states, "*never drive within the hazardous area around an aircraft which has its anti-collision beacons flashing. This indicates that the engines are running or about to be started".*

1.18.6 Anti-collision beacon lights

It is normal industry practice that anti-collision beacon lights are not switched off until all engines have been fully shutdown. In an environment that can be difficult to determine the exact status of the engines, this procedure provides a clear visal signal to the ground personnel. The significance of the anti-collision beacon lights rotating was not understood by a number of ground operatives interviewed. It was further stated that on a number of occasions it was common practice to approach the aircraft with engines running and anti-collision beacon lights on.

1.18.7 Personal Protective Equipment and Clothing

At the time of the accident, the deceased was wearing an approved airside access permit and was dressed in accordance with the Airport Directive No 2, Personal Protective Equipment and High Visibility Clothing.

2 Analysis

The investigation revealed serious deficiencies in apron safety standards, and the monitoring of such standards, that subjected ground handling staff to potential hazards.

Company standard procedures were laid down and, if they were followed, may have prevented the accident. In this instance, a number of Company procedures were contravened on the night of the accident. These included; driving a vehicle within the hazardous area behind an aircraft when its engines were still running and the anti-collision beacon rotating; ground operatives approaching the aircraft with the engines still runnning and the anti-collision beacon rotating; inadequate supervision on the stand to over- see the safety of the operation.

Interviews with ground operatives indicate that a practice had evolved whereby ground handling operatives (with equipment) were approaching aircraft before the engines were stopped and before the anti-collision beacon lights was switched off, thereby contravening the Company's own procedures.

The deceased received no formal training on entry into the Company. However, he did receive some ad hoc on-the-job training during his employment, the amount of which cannot be quantified. While the deceased may have had some familiarity with the situation and the operation, it is unclear as to what level an understanding he might have had, concerning the Company procedures, the specific hazard of propellers/jet engines and the significance of the rotating anti-collision lights.

Training documents received from the Company relating to the proficiency of ground operatives (including the deceased) in the different warehouse and apron disciplines, are not considered as conclusive evidence of training received or standards achieved.

The Airport Operator, who is responsible for the control of apron surface traffic and who is required to regulate the parking of aircraft and the movement of vehicles, equipment and pedestrians on the apron had no input into the training standards achieved by the handling company nor had the Operator any input into the Company procedures, other than to accept the laid down procedures of the IATA Standard Ground Handling Agreement. While it is accepted that the Airport Operator does carry out policing of apron safety standards on an on-going basis, evidence indicates that ground operatives frequently approached aircraft (for non-technical reasons) while engines were running and anti-collision beacon lights were rotating.

The demarcation in areas of responsibilities and how these responsibilities are managed with regard to safety on the ground at airports in Ireland is unclear, as it comes under the aegis of three agencies. The Airport Operator, through their bye-laws/directives is responsible for apron safety in general. The HSA is concerned that any persons employed incidental to the ground operation of an aircraft, should have protection under the provisions of the safety and health legislation. The IAA consider it to be their regulatory responsibility when the aircraft is moving under its own power. However, certain aspects of apron operations (eg aircraft refuelling with passengers on board) are specifically regulated by the IAA.

3 Conclusions

(i) The aircraft had a valid certificate of airworthiness in the cargo category and had been maintained in accordance with the approved CAA schedule.

(ii) The flight crew were properly licensed, rested and medically fit to undertake the flight.

(iii) The deceased was properly rested to undertake his shift duties.

(iv) The deceased did not receive any formal induction training course on ground handling activities or procedures on entry into the Company, however he did receive some ad hoc on-the-job training, the amount of which cannot be quantified.

(v) The handling company had laid down procedures for warehouse and apron operations at the time of the accident and it is considered that these were adequate. However a number of the Companies own procedures relating to apron operations were not adhered to on the night of the accident.

(vi) The deceased approached the aircraft to chock the nose wheel while the engines were still at idling power which was in contravention of the laid down procedures. It is unclear as to what level an understanding the deceased might have had concerning the company procedures, the specific hazard of propellers/jet engines and the significance of the rotating anti-collision beacon lights.

(vii) A practice had evolved whereby ground handling personnel were approaching aircraft, for non-technical reasons, while engines were still running and anti-collision beacon lights were rotating, which was in violation of the Companies own procedures.

(viii) For reasons that could not be determined, the deceased came in contact with the idling port propellor, which resulted in fatal injuries to his person.

(ix) The checking procedures put in place by the management of the ground handling company to monitor the training standards achieved at Dublin Airport were inadequate.

(x) The safety auditing system that had been put in place by management of the ground handling company at Dublin to monitor the safe performance of the ground handling personnel and their compliance with the laid down company procedures was inadequate.

(xi) The monitoring of the apron by the Airport Operator, failed to deter the use of unsafe work practices by employees of the Company.

4 Safety Recommendations

In pursuance of accident prevention the following recommendations are made

4.1 ***That consideration be given to making the regulation and monitoring of ground handling agencies/companies a statutory requirement, and the body appointed should be independent of the Airport Operator.*** **(SR 29 of 1998)**

4.2 ***That training initiatives such as the SCARF programme should be used as a, "minimum standard of training" for all ground handling agencies/companies operating in Irish Airports.(Appendix 1)*** **(SR 30 of 1998)**

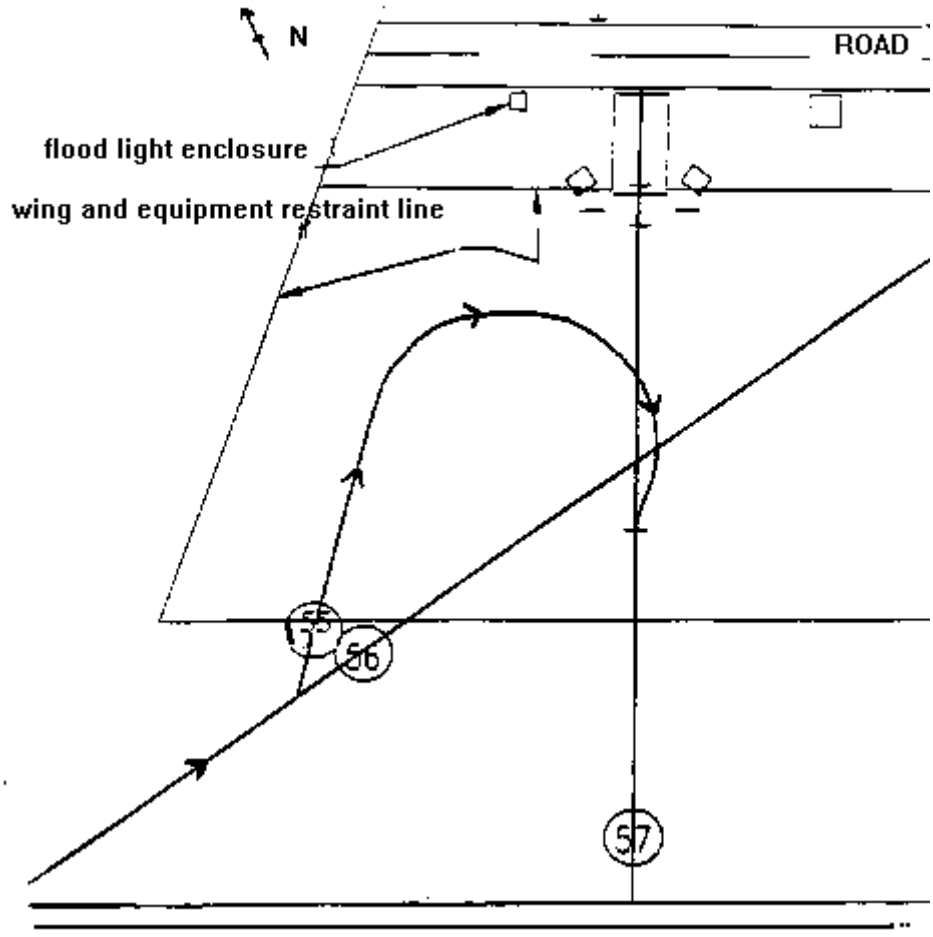
4.3 ***That a working group consisting of the Dept of Transport (Airports Division), the IAA, Airport Operators, the HSA, and representatives of the different ground handling agencies/companies be set up to formulate a set of requirements/criteria for the management and operation of airport apron areas, thereby providing a standard against which these operations will be audited and monitored.*** **(SR 31 of 1998)**

4.4 ***That the provision of CAP 642 be considered by this working group.*** **(SR 32 of 1998)**

4.5 ***That documentation relating to ground handling safety procedures should highlight the significance of not approaching an aircraft while the anti-collision beacon is still switched on.*** **(SR 33 of 1998)**

5. Response to Safety Recommendations

Recommendation No. 4.3	The Department of Public Enterprise accepted this Recommendation.
Recommendation No. 4.4	The IAA has brought the contents of CAP 642 to the attention of aerodrome operators and will continue to do so.



Self Manoeuvring Stand 55
South Apron Dublin Airport

FIG 1

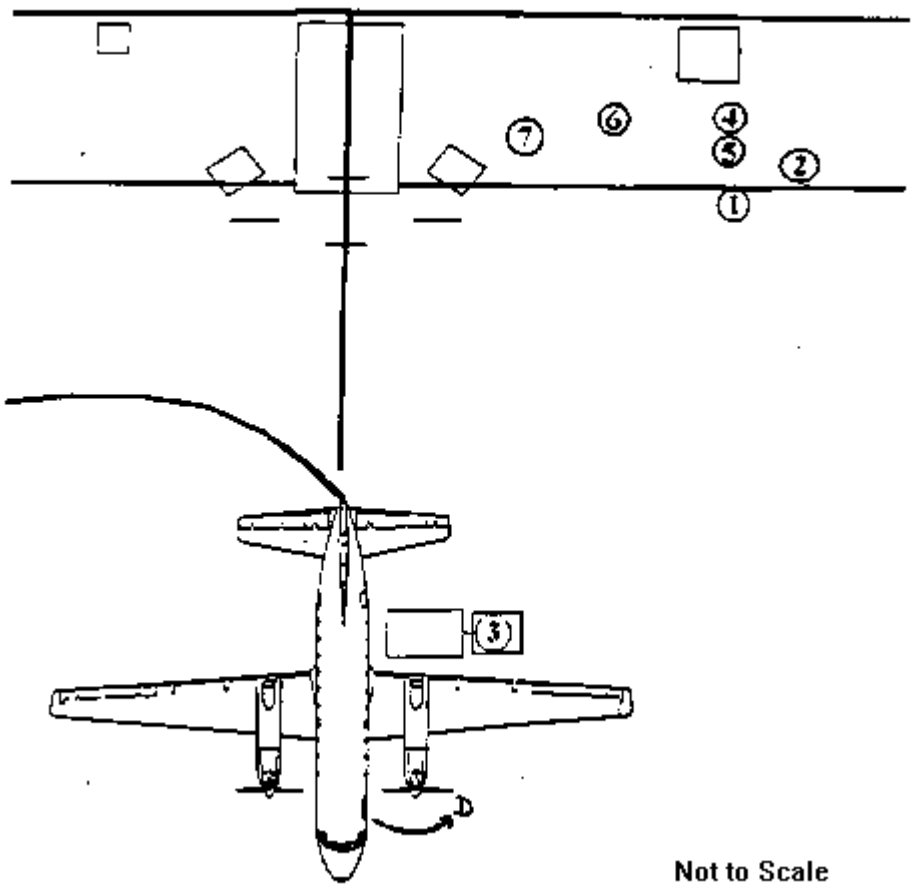
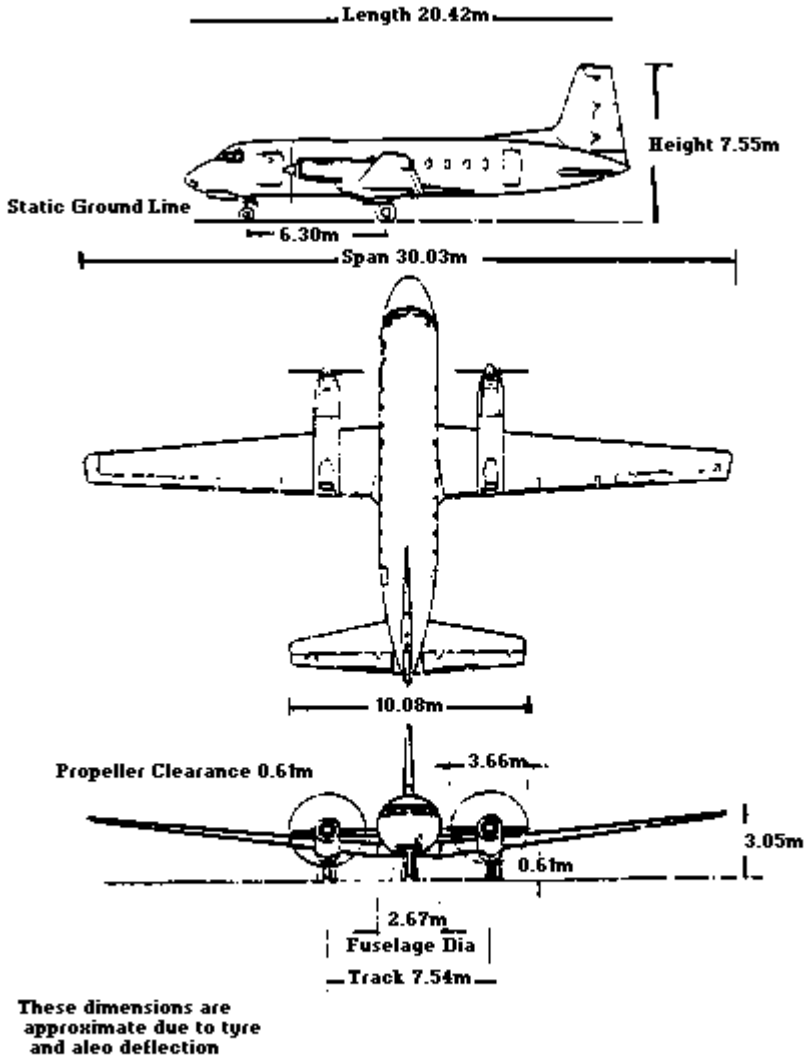


FIG 2

Most Probable Position of Witness Stand 55

Witness No. 1 By Tug at equipment assembly point
Witness No. 2 Walking from car to conveyor at equipment assembly point
Witness No. 3 On Tug and Dolly behind wing
Witness No. 4 On Tug and GPU at equipment assembly point
Witness No. 5 On Tug and GPU at equipment assembly point
Witness No. 6 On conveyor at equipment assembly point
Witness No. 7 Reversing on Tug to hook up trolley at equipment assembly point

Witness D Deceased



Principle Dimensions HS 748

FIG 3

Appendix 1

Accident and Incident Recording and Analysis

An International ramp accident data base was established through a collaboration between the IATA Ground Handling Council Ramp Safety Group and the Aerospace Psychology Research Group of Trinity College, Dublin.

The data base was set up for reports in which damage occurred to aircraft, facilities or equipment during 1993. This ramp accident data base has demonstrated that human factors issues are central to the understanding of safety on the airport ramp, and has also illustrated how it is possible to prioritise areas requiring the most focused attention and investment in order to achieve improvements in *accident prevention*.

The analysis of behaviour as a contributing factor in accidents is fundamental because the operative's behaviour (or lack of it) is typically the final event leading to the accident. Thus, analysis needs to consider the behaviour of the person who experienced the accident or near-miss; the contributing behaviour of others; preventive behaviour which did not occur and the required change in behaviour for safe completion of the task under consideration.

Table (1) below, provides a breakdown of the more important contributory factors which were involved in aircraft-equipment accidents. Failure to follow standard procedures, safety regulations and traffic regulations comprise the most frequently cited antecedents of accidents; visual spatial problems and poor judgement feature prominently; poor discipline is also frequently cited. Defective maintenance of and incorrect use of equipment are common in aircraft-equipment accidents. It should be noted that in most accidents several contributory factors were represented.

Table 1

Aircraft-equipment accidents: Contributory factors	% of accidents
Standard operating procedures not followed	**42**
Spatial misjudgement (distance height or width)	**27**
Safety regulations not followed	**24**
Poor Judgement	**24**
Poor discipline	**14**
Defective maintenance of equipment	**12**
Incorrect use of equipment	**12**

a

Redefining the Role of the Ground Handling Operative

The ground handling operative works with expensive, highly specialised equipment of various types, each making different demands on the operator. He frequently has to work in limited space in the midst of congestion and under conditions complicated by time pressure, noise, jet-blast and all types of weather.

The nature of his job is cyclical and sometimes requires sudden and demanding increases of both mental and physical performance from a resting and perhaps fatigued level. In brief the ramp is an unstable working environment in a number of different ways.

The preferred method in the industry for controlling this instability is to standardise the way the task should be done through the development of standard operating procedures (SOP's). As can be seen from Table 1, in many instances this strategy is failing. Regulations and standard procedures are not being followed and there frequently appears to be a problem of discipline or supervision. There may be a number of underlying reasons for this: for example the standard procedures and regulations drawn up may not be appropriate or adequate, or the task may be inherently resistant to standardisation. However, it is difficult not to suspect that underlying at least part of the problem there may be unresolved and contradictory goals.

Perhaps the most common unresolved contradiction expressed in one form or another by ground handling managers, concerns the requirement for safety on the one hand and on the other, the requirement to maintain a punctual turn-around of the aircraft, despite any delays or disruptions caused by unforeseen events. In principle, standard operating procedures allow the operative little discretion in relation to the correct method of performing an operation. But in practice with a job to be done which is important to the smooth running of the operation, the operative is by default given discretion as to how closely to adhere to the standard procedure.

In this scenario the operative has responsibility to make decisions about acceptable risk. When there is no mishap the immediate payoff is good and this is presumably the most frequent occurrence. When there is an accident however the payoff of the strategy is less clear and for the operative may depend as much on the disciplinary climate and procedures in his organisation as it does on the direct consequences of the accident.

b

Human Factors/Training

From a human factors perspective, reasons for operatives failing to follow standard procedures would include inadequate training, momentary slips, lapses or errors, inadequate motivation and related to this, inadequate organisational support.

The importance of human factors in matching the individual to the task highlights the need for a human factors component in basic training. At all levels of the ground handling operation, from senior management down through supervisory levels to the

operative themselves, there is an education and training function to create a better awareness of human and organisational factors in ramp safety and the competence to manage these factors effectively. Such training may well need to be on a continuing basis, in order to re-establish 'best-practice' where this has fallen away and to maintain competence on equipment and procedures that are only rarely or intermittently used by the individual operative

One initiative which has addressed this objective is SCARF (Safety Courses of Airport Ramp Functions), a five nation joint training action under the EC COMETT programme which involved the co-operation of four European universities and eight aviation organisations with a role in ground handling. This three year project has developed courses on safety in ground handling for operatives, their trainers, supervisors and management, with a particular focus on the human factor. In general three broad approaches to the problem of reducing the frequency of accidents and incidents on the airport apron were taken:

(1) design the work environment and the way work is organised so as to avoid exceeding the mental and physical capabilities of the ground handler and to minimise the effects of human variability in performance,

(2) match the operator more effectively to the tasks and operating conditions demanded of him

(3) provide organisational support for safety as an inviolable condition of operating.

c

Apron Safety (General).

The subject of apron safety for UK registered aircraft was addressed in CAA Notice to AOC Holders (NTAOCH) 1/93 which was published in January 1993 following concerns with regard to the increasing numbers of Occurrence Reports being received appertaining to ground handling incidents. Under the section, "Safety of Ground Handling Personnel," it notes that the duty to ensure the safety of ground handling personnel is covered primarily under the Health and Safety at work etc. Act 1974. Additionally the CAA is concerned that the injury to people could be directly related to aircraft damage and adversely affect operational safety.

It also noted that the nature of the incidents that had occurred suggests that complacency, a lack of awareness of the dangers inherent in the proximity to aircraft as well as inadequate training and procedures have been contributory factors. The

notice re-emphasised that it is the aircraft operating company which is ultimately responsible for the safe operation and fitness of the aircraft for the intended flight.

In situations where it is not possible for the aircraft operator to monitor handling functions directly, it noted that a quality system should be in operation to monitor the agency's performance. It states that '*Quality involvement should be directed towards the manner in which the agency trains and qualifies its personnel for work on and around the aircraft, including its performance monitoring practices and its response to hazardous actions by personnel..'*

Following the publication of NTAOCH 1/93 the UK had an incident whereby a ground operative was fatally injured, having been struck by an aircraft propeller while operating a tug and GPU. In response to the UK AAIB's report (AAIB Bulletin 1/94 ref. EW/C93/3/2) the Authority published the guidance document CAP 642 entitled "Airside Safety Management."

CAP 642 was produced in response to a need for guidance about safe operating practices for all those engaged in activities taking place on the airside areas of airports and aerodromes.

With the support of industry and the UK HSE, the UK CAA established a joint Working Group to look at specific issues concerning aircraft and individual safety in the ground handling phase of airport operations. The move was in accordance generally with the views of the UK Air Accident Investigation Branch. The advice and guidance in CAP 642 is best described as ' Acceptable Good Practice ' and represents an acceptable way of doing things. It illustrates how risks might be identified and provides advice about how airside safety can be placed within the context of a systematic and structured management approach - a Safety Management System.

d

With regard to any apparent overlap of regulatory responsibility between the UK CAA and the UK HSE, the following is noted. *The CAA is responsible for securing adequate provisions for the safety of aircraft and the HSE is responsible for securing adequate provisions for the safety of individuals in the work place. These responsibilities can of course overlap, for example, when a piece of equipment is maintained in such a way that, through incorrect functioning, it hazards its operator whilst also causing damage to an aircraft. However, it is the declared intention of the CAA and the HSE to work together to resolve any overlaps and to detect any potential areas where neither has assumed responsibility.*

Note: Information contained in this appendix relating to the SCARF Programme and Human Factors was willingly contributed by Mr Ray Fuller and Mr Nick Mc Donald of the Aerospace Psychology Research Group, Department of Psychology, Trinity College, Dublin.