Department of Trade

ACCIDENTS INVESTIGATION BRANCH

Vickers Viscount Series 802 G-AOJF Report on the incident at Leeds/Bradford Airport, on 6 November 1978

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List of Aircraft Accident Reports issued by AIB in 1979

No.	*Short Title*	*Date of Publication*
1/79	Piper PA32R (Cherokee Lance) PH–PHY Holly Hill Snodland Kent April 1978	May 1979
2/79	Vickers Viscount Series 802 G–AOJF Leeds/Bradford Airport November 1978	

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Department of Trade
Accidents Investigation Branch
Kingsgate House
66–74 Victoria Street
London SW1E 6SJ

9 October 1979

The Rt Hon John Nott MP
Secretary of State for Trade

Dear Sir

I have the honour to submit the report by Mr P J Bardon, an Inspector of Accidents, on the circumstances of the incident to Vickers Viscount Series 802 G–AOJF which occurred at Leeds/Bradford Airport, on 6 November 1978.

I have the honour to be
Sir
Your obedient Servant

W H Tench
Chief Inspector of Accidents

Accidents Investigation Branch

Aircraft Accident Report No. 2/79
EW/C645

Owner and Operator:	British Airways
Aircraft Type:	Vickers Viscount
Model:	802
Nationality:	United Kingdom
Registration:	G–AOJF
Place of Incident:	Leeds/Bradford Airport
	53° 52′ N 01° 39′ 10″ W
Date and time of incident:	6 November 1978 at 0931 hours
	All times in this report are GMT

Synopsis

The Accidents Investigation Branch of the Department of Trade was initially advised of the incident by British Airways on 21 November 1978, and an immediate investigation was commenced. An air traffic control officer on the staff of the Director of Civil Air Traffic Operations, National Air Traffic Services was appointed as an Inspector of Accidents for the purpose of assisting with the investigation in accordance with Regulation 8(3) of the Civil Aviation (Investigation of Accidents) Regulations 1969.

The incident occurred when a Viscount aircraft, which was taking-off from runway 15 at Leeds/ Bradford airport in reduced visibility conditions, narrowly missed a fire service vehicle parked on the runway centre line. The fire vehicle crew had been taking Runway Visual Range (RVR) measurements and had not heard a previous ATC instruction to move clear of the runway.

The report concludes that the incident was caused by the inadequate control by ATC of fire vehicles operating on the active runway in conditions of reduced visibility. The lack of adherence to standard RTF procedures by ATC and the aerodrome fire service is considered to have been a contributory factor.

1. Factual Information

1.1 History of the flight

The aircraft was operating British Airways flight No. BA5403 from Leeds/Bradford to London (Heathrow), with a scheduled departure time of 0720 hrs. The service had been delayed due to fog conditions which had persisted since the airport's opening at 0645 hrs that morning.

Since approximately 0640 hrs, two fire vehicles, callsigns Leeds 3 and Leeds 9 and each manned by two firemen, had been positioned on the centre line of runway 15/33 for the purposes of taking Runway Visual Range (RVR) observations. Local ATC instructions in force at the time directed that when possible, measurements should be taken from the runway rather than from the associated Runway Observation Posts (ROPs) (See map at Appendix A). Leeds 3, which was positioned at the intersection of runways 15/33 and 28/10, was taking observations in respect of runway 15 whilst Leeds 9, positioned at the intersection of runways 15/33 and 01/19, was taking observations in respect of runway 33. Both vehicles were stationary at their respective positions on the runway centre line, with their engines running and with only their amber obstruction lights flashing.

The control tower was manned by an ATC watch supervisor, an aerodrome controller, and an air traffic control assistant (ATCA). However, during the period leading up to the incident, the Supervisor had left the tower in order to carry out other airfield duties. The aerodrome controller was, *inter alia,* responsible for the overall control of operations on the manoeuvring area and was in direct RTF communication with aircraft on VHF. The control of vehicles was effected through the ATCA who relayed the aerodrome controller's instructions via a discrete UHF frequency. RVR observations were received from both Leeds 3 and Leeds 9 via this UHF channel.

Consequent upon Leeds 3 and Leeds 9 entering the runway at the commencement of the watch period, the aerodrome controller had recorded their presence on the airfield on his flight progress display board, but not in such a manner as would indicate that they were actually on the runway. By 0925 hrs the RVR on runway 15, which was the preferred one for take-off, had improved to approximately 800m and the aerodrome controller at that time cleared the Viscount to start engines. In recognition of the aircraft's imminent departure and because the ATCA was otherwise engaged on the telephone, the aerodrome controller himself instructed the fire tenders on the UHF channel to clear the runway, using the following words:

'THREE AND NINE COULD YOU MOVE TO THE ROPs PLEASE.'

This transmission received the single, but unidentified acknowledgement ROGER, though it was later established that the call came from Leeds 3. At 0927.30 hrs, Leeds 3 reported from the 15 ROP that he could see ten lights. This was the vehicle's first call since being instructed to move to the ROP and confirmed to the aerodrome controller that the vehicle was clear of the runway. The call was acknowledged by the ATCA, who had by that time resumed his watch on the UHF channel. At 0928.30 hrs, there was a further unidentified call on UHF, 'ROP TWELVE LIGHTS'. The ATCA acknowledged this with the words 'NINE ROGER', though, in fact, it was later established that the call came from Leeds 3. Neither vehicle challenged the ATCA's acknowledgement.

Coincident with this exchange at 0928.30 hrs, the aerodrome controller cleared the aircraft to taxy to runway 15 and this was followed at 0929.30 hrs with the aircraft's airways clearance, which was correctly read back.

Being aware that he had not yet received confirmation that Leeds 9 had moved to the 33 ROP, the aerodrome controller states that he then asked the ATCA if the vehicle was

clear of the runway, though he cannot remember the exact words he used. The ATCA believes that the aerodrome controller said, "9 is clear, isn't it?", to which, according to the aerodrome controller, the ATCA replied that the runway was clear of both vehicles. However the ATCA believes that he simply said "Yes" and that the controller replied "Fine". It is also the aerodrame controller's recollection that he put the question a second time to "make absolutely sure".

At 0930 hrs, having received the ATCA's assurance that the runway was clear, the aerodrome controller cleared the Viscount for take-off with the advice that the surface wind was from 150 degrees at 10 knots and that the RVR was 850m.

Leeds 9 had not heard the instruction to move to the ROP and at this time was still on the centre line of the runway facing in the 33 direction. The crew had heard the sound of aircraft engines, which they thought was coming from the direction of the apron, and they were therefore anticipating an instruction at any time to move to the ROP. A few seconds later, they saw the Viscount coming towards them but, because no landing lights were displayed, assumed it to be carrying out a taxying test. It then became apparent that the aircraft was in fact rapidly accelerating towards them and was in the process of taking-off. Realising that there was insufficient time available for them to drive clear of the runway, the crew quickly abandoned their vehicle.

When the crew of the Viscount first saw the fire vehicle, it was as an indistinct shape through the mist, and at first sight appeared to be a building or similar structure off the far end of the runway. However, this impression quickly changed and it became apparent that there was in fact a fire vehicle positioned on the runway ahead of them. At this stage, the take-off run was well advanced with the speed at about 85 knots. The commander immediately decided that there was no practicable alternative to continuing the take-off, and he therefore initiated an early rotation at a speed that he believed to be about 95 knots. The scheduled rotation speed (VR) was 105 knots. The aircraft then became airborne and passed overhead the fire vehicle with a vertical clearance of about 10 feet (as estimated by one of the Leeds 9 crew). Immediately after the aircraft became airborne, the first officer retracted the landing gear in order to achieve the maximum possible clearance from the fire vehicle. The commander of the aircraft then reported the incident to ATC in forcible terms, and almost co-incidentally, the crew of Leeds 9 informed the Tower that an aircraft had just taken off above them and that it had been necessary for them to abandon the vehicle.

Neither vehicle nor aircraft sustained any damage nor did their respective occupants suffer any injury as a result of the occurrence. The aircraft then continued its flight to London Heathrow without further incident.

1.2 Injuries to persons

None.

1.3 Damage to aircraft

None.

1.4 Other damage

None.

1.5 Personnel information

1.5.1 Flight crew

(a) Commander:	Male. Aged 34
Licence:	Airline Transport Pilot's valid until 8 March 1980 rated in Group I on Viscount, Vanguard, Comet variants, Boeing 707, 720.
Medical certificate:	Class I. Issued on 22 June 1978 and valid at the time of the incident.
Instrument rating:	Renewed on 20 December 1977 and valid at the time of the incident.
Competency check:	17 May 1978.
Flying experience:	Total hours all types – 7504 Total hours in command – 2064 Total hours Viscount – 1370 (1294 in command) Total hours in previous 6 months – 207
(b) Co-pilot	Male. Aged 32
Licence:	Airline Transport Pilot's valid until 11 November 1987 rated in Group I on Viscount, Boeing 707/720
Flying experience:	Total hours Viscount – 471 (all as co-pilot).

1.5.2 Air Traffic Control Personnel

(a) Aerodrome Controller:	Male
Age:	27
Licence:	Air Traffic Control Licence
Ratings:	Aerodrome Control issued 11.9.72, Validated 17.10.72. Approach Control issued 19.12.72, validated 5.1.73. Approach Radar Control issued 23.4.75, validated 21.5.75.
Total Experience:	Commenced employment at Leeds/Bradford Airport on 8.4.69; acted as Apprentice ATC Officer for 3 years 5 months; acted in existing capacity as an ATCO for 6 years 5 months.
(b) Air Traffic Control Assistant:	Male
Age:	22
Licence:	NIL
Total ATC Experience:	Commenced employment at Leeds/Bradford Airport on 1.9.77 as an ATC Apprentice.

1.6 Aircraft information

(a)	*Type*	Viscount 802
	Serial No.:	155
	Registration:	G–AOJF
	Certificate of Airworthiness:	Valid until 23 August 1982
	Category:	Transport Category (Passenger).
(b)	*Regulated take off weight* for runway 15 at Leeds in prevailing conditions:	29,257 kgs
	Actual take off weight:	27,615 kgs
	Centre of gravity:	14–15% SMC (mid-range)
	Scheduled rotation speed (VR):	105 knots.
	Theoretical minimum unstick speed:	95 knots.

1.7 Meteorological information

The general weather situation on 6 November was dominated by a large anti-cyclone over central and SE Europe, according to an appreciation prepared by the Meteorological Office subsequent to the incident. Light winds overnight on the 5 November in conjunction with well broken cloud allowed fog to form over parts of the Midlands, East Anglia and the Vale of York. However on the 6 November, depressions over the North Atlantic and SW Approaches caused a tightening of the gradient in the area, resulting in freshening south to south easterly winds. These winds produced stratus, the base of which was low enough to cause hill fog over most high ground. The poor visibility at Leeds/Bradford during the period immediately before the incident was therefore probably due to either this very low stratus or banks of drifting fog. RVR measurements on runway 15 were commenced at 0647 hrs and continued at regular intervals until 0959 hrs when the visibility had improved to the extent that they were no longer necessary. At 0644 hrs, the RVR was 122 metres, and remained close to that value until 0907 hrs when it had improved to 427m. Between then and 0930 hrs, the RVR improved further to 860m. The surface wind was reported at the time as from 150 degrees at 10 knots and the temperature as 8°C.

1.8 Aids to navigation

Not applicable.

1.9 Communications

During the course of the events leading up to the incident, BA 5403 was in contact with Leeds Tower on 123.75 Mhz. Leeds 3 and Leeds 9 were both in contact with ATC via the UHF Domestic frequency. Under normal circumstances, this latter frequency is manned by the aerodrome ATCA although the controller has the ability to assume this responsibility when his assistant is otherwise engaged.

It is normal practice for the Leeds aerodrome controller to operate on the VHF frequency via a headset. In addition to this frequency, he has access to the UHF channel by either of two methods. He has the option of making an additional selection of the UHF frequency to his headset, in which case his transmissions on VHF will be similarly broadcast on UHF (and vice versa) or alternatively, he can use the hand microphone/loudspeaker combination provided for the ATCA's use; in the latter case, transmissions on either the UHF or VHF channels will be discrete.

The layout of the Leeds control tower is such that the ATCA is positioned to the immediate right of the aerodrome controller. Consequently, if the controller wishes to make a transmission on UHF, it is a simple matter for him to reach over and pick up the hand microphone. It was this method which was employed by the aerodrome controller when issuing the instruction 'THREE AND NINE COULD YOU MOVE TO THE ROPs PLEASE'. As a result, this transmission was discrete to the UHF channel and was not similarly broadcast on VHF. More significantly, however, by not making the double selection to his headset, none of his transmissions to BA 5403 on VHF could have been overheard by the two AFS vehicles.

An examination of the RTF transcript at Appendix B reveals certain inconsistencies with the standard phraseology as specified in Section E of the Manual of Air Traffic Services Part 1. Although detailing certain phraseologies, this document cannot attempt to cover every conceivable situation. Nevertheless, certain basic guidelines and cautionary notes are laid down which, in the interests of flight safety, must be followed. It was noted, during the investigation, that the instruction at line 11 of the RTF transcript omits any requirement for Leeds 3 and Leeds 9 to report clear of the runway and at line 13, there is the transmission and acceptance of the single word 'ROGER', with neither the originator nor the recipient establishing the identity of the call. Similarly, at line 27, there is the unidentified transmission 'ROP TWELVE LIGHTS'. It is significant at line 33 to note that the subsequent incorrect acknowledgement 'NINE ROGER', (since the call was made by Leeds 3), was not questioned by either vehicle.

Although having no direct bearing on the incident, it was noted that on two previous occasions earlier that morning, the aerodrome ATCA had incorrectly acknowledged RVR light reports from the AFS vehicles. On neither occasion were these acknowledgements challenged by the crews of Leeds 3 and Leeds 9.

1.10 Aerodrome and Ground Facilities (See plan at Appendix A)

The main runway at Leeds Airport, which is aligned 15/33, has a concrete surface and is 1646 metres long by 46 metres wide. In addition, two subsidiary asphalt runways are provided which intersect the main runway. Runway 10/28 crosses approximately 300 metres from runway 15 take-off threshold whilst runway 01/19 crosses approximately 500 metres from runway 33 take off threshold.

At the time of the incident, RVRs were measured by two different methods at Leeds. The preferred system required observations of the number of runway lights to be made from a position on the centre line of the runway. These observations were passed by UHF to ATC who, by multiplying the number of lights reported by the distance between those lights (61 m), obtained the equivalent RVR value. When the runway was in use however, the AFS vehicle moved to the ROP located adjacent to the end of the runway itself and clear of the ground swing envelope. In this latter case, the number of lights observed by the AFS on the far side of the runway were converted to an RVR value by ATC from a table prepared by the Meteorological Office. Experience suggests that for a given visibility condition, RVR values obtained from centre line measurement were generally higher – and therefore more advantageous to the airport's operations – than those obtained from the ROPs. However, this was not the original reason for introducing this system of centre line measurement.

Owing to the existence of a public road to the immediate north west of runway 15 threshold, the landing threshold for this runway is displaced. Consequently, the runway edge lights are coloured red as far as this displaced threshold. The net result is that since only the white edge lights may be used for RVR measurements, the minimum RVR value which could be obtained from runway 15 ROP was 270 metres. Since this did not meet the needs of the airport's main civil air transport user, whose minima for take-off on runway 15 was 150 metres, the airport commandant wrote to the Civil Aviation Divisional Office (Northern Division) of the then Board of Trade on 6 May 1969 to seek approval for a different system of RVR measurement to meet that particular operator's requirements. He proposed that a fire vehicle be positioned on the centre line of runway 15 as near to the threshold as possible and directly between two opposite ZA 105 light fittings with an observer on the cab roof counting the visible lights down one side of the runway in the normal way. The RVR would then be derived by ATC by multiplying the number of lights observed by the distance between them. The Divisional Office replied by letter on 13 May 1969 that it had no objection to the airport commandant's proposal provided that exactly the same position was used on each occasion with a trained observer taking the visibility readings two or three minutes before an aircraft took off. The Divisional office letter went on to say, however, that an alternative method, not involving the stationing of vehicles on the runway, was preferred whereby RVR lights were installed 150 and 200 metres from the 15 ROP. The airport management examined this proposal in some detail, but it was not pursued since at the time the outcome of a public inquiry into a proposed runway extension project, which would have included lighting changes, was awaited. In the event, the runway extension was not approved and the airport management accordingly sought ways to improve the existing runway lighting. However, the necessary authority to make these changes was not obtained and the practice of measuring RVRs from the centre line continued from that time until the incident occurred some nine years later. The practice was extended to include also runway 33, though this exceeded the terms of approval for centre line measurement as contained in the Divisional Office's letter of 13 May 1969, which applied only to runway 15. However, the Office was made aware that centre line RVR measurement was taking place on runway 33 by a Meteorological Office report on an inspection of the airport's meteorological facilities in 1970. The Divisional Office had no comment to make in a covering letter to the report, which it described as 'good'. Since the incident occurred, the proposal to install RVR lights as originally suggested by the Divsional Office has been receiving active consideration.

1.11 Flight Recorders

The aircraft was fitted with a Plessey PV 710 digital flight data recording system utilising a Davall Type 980 recorder. The unit was installed aft of the rear pressure bulkhead. The record showed that the aircraft rotated at or very close to its scheduled VR of 105 knots and achieved a pitch attitude of 7 degrees nose up.

No cockpit voice recorder (CVR) record of the incident was available since the flight to London outran the 30 minute duration of the tape.

1.12 Wreckage and impact information

Not applicable.

1.13 Medical and pathological information

Not applicable.

1.14 Fire

Not applicable.

1.15 Survival aspects

Not applicable.

1.16 Tests and research

Not applicable.

1.17 Other information

1.17.1 Annual inspection of ATC facilities

The air traffic control unit at Leeds/Bradford airport is not a unit within the Civil Aviation Authority (CAA), but is still nevertheless subject to annual inspection by the Authority's Inspectorate of Air Traffic Control (IATC). The Inspectorate's function is to assess the competence of individual controllers to exercise the privileges of the validations contained in their licences as well as reporting on the facilities and operational practices and procedures of the unit itself. Prior to the incident, the most recent inspection conducted at Leeds/Bradford by the IATC took place on 2 and 24 October 1978, the previous inspection having been on 15 November 1977. Owing to the nature and objectives of these inspections, they are only conducted when the prevailing weather conditions permit normal operations. Consequently, controllers are rarely seen by the Inspectorate when operating in RVR conditions, such as obtained at the time of the incident.

In making an assessment of the efficiency of the unit, the Inspectors check that local ATC instructions are properly amended and do not conflict with the provisions of the Manual of Air Traffic Services Part 1. The Inspectorate's task in this respect has been complicated by the fact that the content and format of local ATC instructions at non-CAA units has tended to vary to a large extent although action has been initiated by the CAA (towards the end of 1977) to standardise these documents. Non-CAA ATC units are currently producing local documents in accordance with this standard format, although those pertaining to Leeds/Bradford had not yet been finalised at the time of the incident. Consequently when all units have complied with the recommendation, it should be easier for the Inspectorate to monitor the content of these documents.

Notwithstanding the fact that hitherto Leeds/Bradford's ATC instructions were not in the standard format, they were nevertheless comprehensive and in respect of RVR procedures contained the following:

'Local ATCI No. 90

Runway Visual Range

sub para 4.

ATC Officers are reminded that the most desirable place from which to take RVR measurements is the centreline of the appropriate runway, and all RVR measurements should be taken from such positions wherever possible. When, for operational reasons, this becomes impossible, then the RVR measurements will be made from the appropriate ROPs. There can be however, a discrepancy of some hundreds of metres in RVRs as measured from the runway centreline and ROPs, which at critical RVRs could mean the difference between the pilot legally attempting an approach and having to divert elsewhere. When conditions are marginal therefore, RVRs should be checked from the centreline of the runway as often as possible, and recourse made to the ROPs only when absolutely essential. The full time fire personnel have been fully briefed on both

methods of measurement, and are aware of the necessity to maintain radio contact from the centreline of the runway.

Note: The distance between runway lights is 61 metres'.

It was apparent during the investigation that the Inspecting Officers of the IATC had not been aware of the details of this instruction. Indeed on the last annual inspection report under the sub-heading 'METEOROLOGY', it was simply recorded that RVR measurement was available on runway 15/33 and that this was effected by AFS observation and ATC calculation.

1.17.2 Manual of Air Traffic Services Part 1 – Measurement of RVR

With respect to Runway Visual Range, the Manual of Air Traffic Services Part 1 contains the following information in Section 3, Chapter 3 under the heading Human Observer Method:

> "This method utilises human observation of a number of runway markers; runway lights; gooseneck flares or electric reference lights which can be seen from a point (elevated if necessary) near the edge of a runway adjacent to the touchdown zone."

1.17.3 Air Traffic Control Instructions

Supplementary Instruction No. 1 of 1978 contained in the Manual of Air Traffic Services Part 1, which was current at the time of the incident, draws the attention of all concerned to the importance of correct and unambiguous use of RTF phraseology and procedures. The Instruction also goes on to state that by adhering to these phraseologies and procedures, there is less likelihood of confusion.

1.17.4 Training of AFS personnel

Approximately 10 years ago, and consequent upon taking up his post at Leeds/Bradford, the Airport Operations Officer gave a full briefing to the Aerodrome Fire Officer (AFO) in respect of RTF phraseologies and procedures. Since that time, the responsibility for training individual firemen in this respect has been vested in the AFO. In the absence of any formal documentation regarding specific phraseologies and procedures, it is clear that this information had been simply passed-on by word of mouth over the years. However, since the incident occurred, individual firemen have been issued with written RTF phraseologies and procedures relevant to their operations on the manoeuvring area. These have been extracted from Civil Aviation Publication CAP 413, entitled "Radiotelephony Procedures and Phraseology" and will form the basis of future RTF training of all AFS personnel.

1.17.5 Flight Progress Board Display

The system employed by aerodrome controllers for displaying flight progress strips (FPSs) varies in small detail between individual units, but generally follows a fairly standard pattern. FPSs are normally accommodated in a horizontal or sloping board which is divided in such a manner as will indicate in a general sense, the state of activity of particular flights. It is common practice for the upper part of the display to be allocated to aircraft either on the approach to land or awaiting take-off at the holding point whilst the lower part is used for aircraft which have just taken-off. The central part of the display is normally reserved for aircraft which are using or have been issued with a clearance to use, the active runway.

As regards the method of displaying the whereabouts of vehicles on the runway in use, there is far less consistency. At some airfields it is a systematic practice to place a "blocking" strip in that part of the display board pertaining to the runway in use. However, at Leeds/Bradford, whereas the aerodrome controller recorded the presence on the airfield of Leeds 3 and 9 on a spare FPS, he did not place this in the 'runway' portion of the display board. Consequently, it was necessary for him to rely upon his memory that the runway was obstructed by the two fire vehicles.

1.17.6 Remedial Action

Following the incident, Leeds/Bradford Airport management took steps to prevent a recurrence. These involved:-

(a) the withdrawal of the system of measuring RVRs from the runway centre line;

(b) the issue of concise instructions regarding RTF phraseology and procedures to all AFS personnel;

(c) the issue of a reminder as to the RTF phraseology and procedures associated with vehicular movements to ATC personnel.

1.17.7 Recent accidents and incidents

Insofar as can be ascertained from ICAO and other sources, there appear to have been at least five other occasions within the last two years when a collision or near collision took place on the active runway. In each case, there was an ATC involvement. The occasions were as follows:

Date	Aircraft or Vehicle	Place	Type of Occurrence
27.3.77	B747/B747	Teneriffe	Collision
14.3.79	Sabre 60/Mooney M20	New Orleans	Collision
21.6.78	DC9/Citation	La Guardia	Near collision
20.12.78	BAC 1-11/Snow Plough	Dusseldorf	Near collision
14.2.79	B747/B727	Chicago	Near collision

In a recent report, the United States' NASA Air Safety Reporting System stated that "though few aircraft collisions have occured on or immediately above runways at controlled airports, incidents involving incursions of aircraft or surface vehicles into aircraft movement areas have been a continuing source of concern."

The report went on to cite 165 occurrences which took place in North America between 1 July 1976 and 30 June 1978 of which 135 involved "threatened or actual conflict." NASA's analysis of these occurrences showed that 109 of them involved public transport aircraft. Of the 165 occurrences, it was shown that 54% involved an error by ATC personnel, 39% by flight crew and 4% by the drivers of surface vehicles.

Among the fifteen factors that NASA identified as contributing to these occurrences were included co-ordination and phraseology problems on the part of ATC personnel and poor meteorological visibility conditions. In its conclusions, NASA stated that "a failure of information transfer among the relevant system participants" was an important factor.

2. Analysis

2.1 *General*

The underlying reason for the incident was undoubtedly a breakdown in the ATC system for ensuring that the runway was clear of all obstructions prior to the issue of a take off clearance to a departing aircraft. It occurred at an otherwise efficient ATC unit though, in respect of the control of vehicular movements – particularly of AFS vehicles engaged in measuring RVRs – it was evident that RTF standards had fallen below that required by the Manual of Air Traffic Services Part 1.

2.2 *RVR Measurements from the runway centre lines – implications*

In good weather conditions and within the limitations of line of sight, an aerodrome controller can always maintain visual surveillance of the area under his jurisdiction. Consequently, any failures in the ATC system for ensuring that the active runway is clear of obstructions have a reasonable chance of being corrected before an aircraft is cleared for take-off or landing. Obviously, this is not so in the case of operations during RVR conditions and, consequently, the ATC system for ensuring that the runway is clear must in itself be essentially fail-safe. The development of such a system necessarily involves aerodrome managements in a considerable amount of planning in order to ensure that as far as is reasonably possible, the consequence of a single error do not affect flight safety. As demonstrated by this incident, the system in use at Leeds/ Bradford for measuring RVRs from the runway centre line was inconsistent with that fail-safe principle. The procedure certainly met a particular operator's requirements, in as much as for the same visibility condition a higher and more advantageous value of RVR could be obtained from the runway centre line than from the associated ROP, but it created a situation that allowed no margin for error on the part of ATC for ensuring that the runway was clear. With the benefit of hindsight, it can be seen that RVR measurements from the runway centre line was ill-advised and ought not to have been approved. It is considered that more thought should have been given by all concerned to the alternative proposal made by the Divisional office in 1969 (as detailed in para 1.10) that would not have involved stationing vehicles on the runway. Though the movement of vehicles on the active runway in low visibility conditions is unavoidable at times, it must be for exceptional reasons and then only under positive control.

2.3 *The Aerodrome Controller*

The responsibility for ensuring that the runway was clear rested with the aerodrome controller, notwithstanding the fact that his communications with the AFS vehicles are generally effected through the ATCA. However, it has already been established that the original instruction on UHF for Leeds 3 and Leeds 9 to clear the runway was issued by the controller himself. Since the intent of the instruction was of such fundamental importance to the safe departure of BA 5403, it is considered that each vehicle should have been addressed separately, and the requisite acknowledgements obtained. In addition, a specific requirement for each vehicle to report clear of the runway should have been included. Having examined the transmission which in fact was made, viz THREE AND NINE COULD YOU MOVE TO THE ROPs PLEASE it is suggested that a more positive statement of the requirement would have been achieved by the following:

TWR: 'Leeds Three clear runway 15 to the ROP and report clear'.
LEEDS 3 'Wilco Leeds 3 will report clear'
and subsequently
TWR: 'Leeds Nine clear runway 33 to the ROP and report clear'
LEEDS 9: 'Wilco Leeds 9 will report clear'

The aerodrome controller's acceptance of the single acknowledgement ROGER to his instruction to both vehicles to move to their respective ROPs, left unresolved the question that should have been uppermost in his mind, namely that both vehicles had received his instruction and were acting upon it. He reasoned later that it was not of overriding importance that he should resolve this question immediately since it was not uncommon for only one vehicle to reply to an instruction of this nature, and in any case, his first consideration was to attend to the movement of BA 5403. This is surprising since his workload was certainly not very high and consequently it rather suggests that he did not attach any particular importance *at that time*, to the requirement for the two vehicles to clear the runway. It must be emphasised however, that he was in no doubt that he still required confirmation that both Leeds 3 and Leeds 9 were moving to their respective ROPs. With respect to Leeds 3, that confirmation was provided in effect by the transmission at 0927.30 hrs viz'ONE FIVE ROP TEN LIGHTS'. It was learnt during the investigation that this was a fairly common method by which Leeds/Bradford ATC confirmed that a vehicle was clear of the runway.

Having passed the airways clearance to BA 5403, the aerodrome controller then asked the ATCA whether or not Leeds 9 had cleared the runway. It has not been possible to establish the exact form in which this question was posed but it is possible (according to the ATCA's recollection) that it was directed in a somewhat leading manner, ie "9 is clear isn't it?". However, whatever the manner in which the question was put, the aerodrome controller obtained a response which indicated that Leeds 9 was clear of the runway. The significant point which was established during the investigation was that notwithstanding his receipt of this confirmation, the aerodrome controller recollects having asked the question a second time in order to make 'absolutely sure'. Since this was almost inevitably bound to produce the same response, it would seem that he would have done better, if he wanted absolute assurance, to have checked the position of Leeds 9 on UHF himself, or instructed the ATCA to do so. As it was, he placed total reliance on the ATCA's appreciation of the situation, which as has been shown, was faulty.

2.4 *The Aerodrome ATCA*

It is apparent that on the day in question, the aerodrome ATCA was prone to making mistakes on RTF. This culminated in his erroneous assumption that the call at 0928.30 hrs viz. ROP TWELVE LIGHTS, came from Leeds 9. Though he has since stated that at the time he regarded the call as providing confirmation that Leeds 9 was clear of the runway, it is also possible that he simply accepted the call as a report of the number of RVR lights observed by the crew of that particular vehicle and nothing else. On balance this seems the more likely explanation since if he did appreciate that this call also implied that Leeds 9 was clear of the runway, it is not understood why he did not then advise the controller accordingly. In addition, it might have been expected that he would also have been more careful over establishing the identity of the vehicle making the transmission if he did believe this to be a 'runway clear' report. A more likely explanation of the ATCA's actions is that by the time he received the ROP TWELVE LIGHTS report, he already believed both vehicles to be clear of the runway. He had earlier overheard the controller instructing both vehicles to move to their respective ROPs, though he had not heard their response as he was on the telephone at the time. However, he would have had no reason to expect the vehicles to respond other than positively, and in the absence of any advice to the contrary from the controller, he could well have assumed that the vehicles were in fact clear at that stage. If this explanation is correct, then the aerodrome controller's query as to the whereabouts of Leeds 9 – particularly if it were addressed in a leading manner – would inevitably produce the answer which in fact was forthcoming.

Unfortunately it did not occur to the ATCA to confirm with the vehicle's crew his belief that Leeds 9 was at runway 33 ROP. There is no evidence that the ATCA's actions were in any way due to his workload being too high at the tine, and this possibility has therefore been discounted.

In summary, it is considered that the aerodrome ATCA did not fully appreciate the dangers inherent in faulty RTF communication. He was trained in an environment where certain non-standard practices had been introduced over the years and did not have the depth of experience to appreciate the risks inherent in such practices. This is particularly so as regards the process of establishing that the runway was clear.

2.5 *The Aerodrome Fire Service*

It is apparent that the training in RTF phraseology and procedures received by the crews of Leeds 3 and Leeds 9 was of an informal nature. The briefing given to the Aerodrome Fire Officer (AFO) had taken place some 10 years before the incident, and the subsequent assimilation of this information by individual members of the AFS had been achieved on a verbal basis. Undoubtedly the level of awareness that such a method of training engenders will be comparatively low. This is confirmed by the RTF transcripts, where the crews of neither vehicle challenged the three incorrect acknowledgements issued by the aerodrome ATCA during that morning. Had a more formal training been given, the AFS personnel would have recognised more fully that it is incumbent upon the individual making a transmission to ensure that the correct acknowledgement is received.

As regards the events immediately preceding the incident, the crew of Leeds 9 stated that they could hear aircraft engines running but assumed that this was coming from the apron. Unfortunately, since the aerodrome controller had not made a dual selection of both VHF and UHF frequencies to his headset, they did not hear the transmission from the Tower to BA 5403. Nevertheless, they were anticipating an instruction to move to the ROP any moment. It was established that on a general note the crews of AFS vehicles stationed on the runway during RVR conditions feel somewhat exposed. This is quite understandable but does not appear to have engendered any greater awareness, probably because of the crew's complete faith in ATC. Since they were apparently aware, or suspected, that an aircraft was shortly about to depart, it is a little surprising that the crew of Leeds 9 did not confirm their presence on the runway to the Tower, which might have been the prudent thing to do in the circumstances. Their last exchange with ATC had in fact taken place some five minutes earlier and before the vehicles were instructed to move to their ROPs by the aerodrome controller.

It has not been possible to establish why Leeds 9 did not receive the instruction to move to the ROP. No evidence exists as to 'blind' areas in the UHF coverage – indeed communications had been normal with the Tower up until that point. It can only be deduced that because the vehicle's engine was running, the transmission might have been swamped, particularly since it is normal practice for the engine rpm to be increased on occasions for a period of 15 seconds or so. As regards the crew's decision to abandon their vehicle rather than attempt to drive it clear, it is accepted that they had little option in the time available to do otherwise without considerable risk to themselves.

2.6 *Other Factors*

2.6.1 *Inspection of ATC Units*

The only possible means by which the Inspectorate of ATC could have identified and questioned the procedure whereby RVR lights were measured from the runway centre line was by reference to the local ATC Instructions. However, it must be recognised that

the Inspector's mandate is of a fairly general nature and it would have been impracticable for them to study every detail of Leeds/Bradford ATC's operating procedures. Even if they had been aware of the details of the particular instruction relating to RVR measurement, it is unlikely that specific comment would have been made.

2.6.2 *Use of RTF at Aerodrome*

For the most part the control of surface traffic at the majority of airfields is achieved solely by the use of RTF communications. Whereas controllers and pilots are generally well versed in the associated phraseology and procedures, it is questionable whether or not this is true of the other users e.g. vehicle drivers. Since the safety of the whole operation rests entirely on the use of clear and concise RTF, it is considered essential that such personnel demonstrate an acceptable standard in this respect and have a sound knowledge and understanding of the phraseology and procedures associated with their particular type of operation. It is considered that it is the responsibility of all aerodrome managements to ensure that this standard is achieved at their particular airfields. Sufficient guidance is already available (eg Civil Aviation Publication CAP 413 – RADIOTELEPHONY PROCEDURES AND PHRASEOLOGY).

As regards the use of split UHF/VHF frequencies at aerodromes, there are undoubtedly sound reasons for making use of a separate UHF frequency for vehicular traffic. However, where a particular vehicle is required to operate on a runway as opposed to simply crossing it, it is considered essential that communications should be effected via the same VHF frequency as that used by aircraft. Although it is recognised that the ATC system should in itself be adequate to ensure that the runway is clear before aircraft take-off or land, this additional requirement would undoubtedly enhance the safety of the operation.

On a more fundamental matter of principle, consideration has to be given to the concept whereby aerodrome controllers exercise control of vehicular traffic through an ATCA. This is not peculiar to Leeds/Bradford, it being the normal method of operation at several other aerodromes within the UK. The practice has been introduced as a means of reducing the aerodrome controller's RTF workload, both in respect of the number of calls which he would otherwise have to respond to, in addition to the difficulties of manning two frequencies at the same time. However, by introducing a third party into the communication link between controller and vehicle driver, the possibility of error is inevitably increased. Consequently, consideration has been given to other means by which a reduction in the controller's workload may be achieved.

Firstly, it is questionable whether or not all the calls made by vehicles are in fact essential. The majority will, in most instances, involve movement on the manoeuvring area which does not involve penetration of the active runway. Consequently, it is reasonable to suggest that provided drivers are well briefed, there is no reason why they cannot proceed on to the taxiways/apron areas using the "see and be seen" principle, but without requiring specific clearance from ATC. Obviously visibility minima will need to be included in such an arrangement but there would not appear to be any fundamental objection to its application; indeed such a system is currently in use at London Heathrow and is understood to work well.

Secondly, one needs to consider the manner by which an aerodrome controller could effect communications with a vehicle wishing to cross the runway, but which is only fitted with UHF. It is accepted that to require the controller to operate on two separate frequencies is undesirable, but by cross coupling the relevant VHF and UHF frequencies the end result is virtually the same as presenting the controller with one single RTF frequency. By selecting his RTF frequency, he is able to receive and transmit on both VHF and UHF, and, depending upon the particular type of cross coupling arrangement, vehicles will hear aircraft transmissions and vice versa. It is considered that such an arrangement would offer considerable overall benefits to flight safety.

If these arrangements were still to present the controller with a higher than average RTF workload, then it is probable that there is a need for a split controller function within the Tower, that is a Ground Movement Control and an Air Control. Although this would undoubtedly by an expensive option for some aerodrome authorities, it has the major advantage that each controller can exercise direct responsibility for the area under his jurisdiction, and for this reason alone, should receive serious consideration in preference to the employment of an ATCA acting as a communicator.

2.6.3 *Use of Flight Progress Board Displays.*

Although not a factor in this incident, it was noted that no specific instructions exist either nationally or locally, as to the method of indicating to the controller that the runway is obstructed. It is fairly general practice for a portion of the aerodrome controller's display to be representative of operations taking place on the runway in use. Flight Progress Strips (FPSs) pertaining to flights which have been issued with clearance to use the runway (eg cleared to land, landed, cleared to line up, cleared for take-off) are normally placed in this part of the display in order to give a clear indication of the relationship between different movements. However, it is apparent, particularly at Leeds/ Bradford and probably at certain other airfields as well, that no standard system is employed in order to show that the runway is obstructed. This could be achieved quite simply by requiring a "blocking strip" to be placed in the appropriate part of the display whenever a vehicle is cleared, for example, to cross a runway, which, by its position in relation to other FPSs, will clearly indicate the particular aircraft that will be affected by this clearance. Such a system would obviate the necessity for controllers to have to rely solely on memory when assessing whether or not the runway is clear for aircraft taking-off or landing.

2.7 *The need for further development*

The number of accidents and incidents in recent years throughout the world involving collisions or near collisions on the active runway between one aircraft and another or between aircraft and vehicles is disturbing. The incident at Leeds/Bradford can be seen therefore to be part of a continuing trend. This in part seems to be due to the near total dependence of ATC on RTF procedures alone to establish the position on the manoeuvring area of aircraft and vehicles under its control. Notwithstanding the Airfield Surface Movement Indicator (ASMI) System, the absence of more positive methods whereby ATC can be provided with completely reliable information as to the position and identity of surface movements must constitute a challenge to those concerned with the development of air traffic control systems, and it would seem that the matter ought to be accorded high priority.

3. Conclusions

(a) *Findings*

(i) The aircraft was correctly loaded and its documentation was in order.

(ii) The flight crew held the requisite licences and ratings.

(iii) The aerodrome controller was properly licensed and held the requisite validations.

(iv) The air traffic control assistant was unlicensed and was not required to be licensed.

(v) Approval to make RVR measurements from the runway centre line at Leeds/Bradford airport was sought from the appropriate authority by the airport management in order to accommodate the requirements of local operators. Whilst giving its approval for this, the then Board of Trade nevertheless recommended an alternative method, not involving centre line measurement, but this was not pursued by the airport management.

(vi) The aerodrome controller was responsible for ensuring that the active runway was unobstructed before clearing BA 5403 to take-off but he did not properly discharge that responsibility.

(vii) The aerodrome controller did not conform wholly to the provisions of the Manual of Air Traffic Services Part 1 as regards RTF phraseology with respect to his control of vehicular movements. Had he done so, the incident would most probably have been avoided.

(viii) The air traffic control assistant did not exercise sufficient care in the performance of his duties during the period leading up to the incident, particularly as regards his acceptance of unidentified RFT transmissions on the UHF channel and his unsupported assumptions as to the whereabouts of the fire vehicles.

(ix) The aerodrome fire service had been allowed to operate to a low standard of RTF discipline.

(x) Though not a factor in the incident, it is considered undesirable that there is no provision made in MATS Part 1 for indicating on the Flight Progress Board the presence of a vehicle on the active runway.

(xi) The continuing dependence of ATC generally on RTF procedures alone to determine the identification and position of aircraft and vehicles on the manoeuvring area in conditions of reduced visibility is a flight safety hazard.

(xii) The Inspectorate of Air Traffic Control (IATC) was unaware that RVR measurements at Leeds/Bradford airport were made from the runway centre line and that this had the approval of the former Board of Trade. It was not a requirement that IATC include in their annual inspections an appraisal of the airport's RVR measurement facilities, but merely to note that such facilities were provided.

(xiii) The aircraft commander took prompt and decisive action to avert a collision with the fire vehicle. The avoidance of the collision was nevertheless entirely fortuitous.

(b) *Cause*

The incident was caused by the inadequate control by ATC of fire vehicles operating on the active runway in conditions of reduced visibility. The lack of adherence to standard RTF procedures by ATC and aerodrome fire service personnel was a contributory factor.

4. Safety Recommendations

It is recommended that:

4.1 Approval for the measurement of RVRs from a runway centre line be no longer given in any circumstances.

4.2 The crews of all vehicles that may at any time operate on the manoeuvring area whilst in RTF contact with ATC should receive formal training with respect to RTF procedures. In addition, they should have readily available to them a copy of CAP 413 'RADIO TELEPHONY PROCEDURES AND PHRASEOLOGY". The issue of an appropriate certificate of competence to operate the radio of aerodrome vehicles might also be considered.

4.3 When a device to cross couple VHF and UHF transmissions is not being utilised, all vehicles operating on the active runway should be on the same RTF frequency as the aircraft using that runway.

4.4 The MATS Part 1 should specify a standard procedure for the use of the Flight Progress Board, which should also incorporate a method whereby it can be shown that the active runway is blocked.

4.5 In those instances when the workload of the aerodrome controller is normally such that he cannot directly control the movement of vehicles on the manoeuvring area, consideration should be given to the establishment of a Ground Movement Control in preference to the employment of an air traffic control assistant for this purpose.

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